(REVIEW ARTICLE)

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A literature review on the parameters for evaluating Coronary Artery Bypass Grafting (CABG) Outcomes

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Abstract

Coronary Artery Disease (CAD) remains a leading cause of death globally, contributing to millions of fatalities each year. Coronary Artery Bypass Grafting (CABG) is one of the most common and effective surgical treatments for CAD, designed to restore blood flow to the heart by bypassing blocked coronary arteries. While CABG has proven to improve survival rates and relieve symptoms, the evaluation of outcomes remains crucial. This review examines several key parameters for assessing CABG outcomes, including Quality of Life (QoL), cardiac biomarkers, the SYNTAX score, Major Adverse Cardiovascular Events (MACE), and postoperative complications and highlights the ongoing need for refined predictive models and clinical decision-making tools to improve patient outcomes after CABG. Future research should focus on optimizing these parameters to better predict and enhance the results of CABG procedures.

Keywords: Coronary Artery Disease; Coronary Artery Bypass Grafting; Outcomes

1. Introduction

Coronary Artery Disease (CAD) is a condition in which plaque forms in the lumen of the coronary arteries, obstructing blood flow and leading to an inadequate supply of oxygen and nutrients to the myocardium. (Elosua et al., 2014) It accounts for approximately 7 million deaths and 129 million Disability-Adjusted Life Years (DALYs) annually (Ralapanawa & Sivakanesan, 2021), making it a leading cause of death in the globally. In the early 20th century, coronary artery disease was often an unexpected cause of death, frequently resulting in sudden cardiac death. The peak of mortality due to coronary artery disease occurred in the mid-1960s, after which it started to decline. However, it remains the leading cause of death worldwide. (Elosua et al., 2014)

One of the major interventions for managing coronary artery disease is Coronary Artery Bypass Grafting (CABG), a surgical procedure that has been proven to be an effective treatment to extend life and alleviate symptoms in patients (Cohn, 2010). CABG involves bypassing the obstruction caused by atheromatous plaques in the coronary arteries by creating new pathways for blood flow, using blood vessels (either veins or arteries) taken from the patient's body. These grafts restore blood circulation to the myocardium, alleviating the effects of the arterial blockage (Bachar and Manna, 2023).

Numerous studies have been conducted to evaluate the outcomes of CABG, and several parameters have been utilized to assess the effectiveness of the procedure. For instance, Major Adverse Cardiac Events (MACE), which include incidents of myocardial infarction, repeat revascularization, cardiac mortality, and overall mortality, have been commonly used as outcome measures in assessing the success of CABG (Kamel et al., 2018). Additionally previous study

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showed changes in Quality of Life (QoL) before and after the surgery are also important metrics in evaluating the impact of the procedure on patients' health and well-being. (Barolia et al., 2012)

Although there is a substantial body of research on the outcomes of CABG, the ongoing need to evaluate the effectiveness of therapeutic strategies like CABG remains crucial. This article aims to investigate deeper into the specific parameters that can be used to more accurately measure the effectiveness of CABG. Additionally, it will provide insights into the key parameters that should be considered in future research to optimize CABG outcomes and improve patient prognoses.

2. Review Content

2.1. Quality of Life

Quality of life (QOL) refers to the level of well-being experienced by an individual or group. It encompasses various aspects such as health status, physical functioning, perceived health, subjective health, symptoms, satisfaction with needs, cognitive function, functional impairment, mental health disturbances, and overall well-being. At times, it may encompass more than one of these dimensions simultaneously (Hunt, 1997). The use of quality of life (QOL) assessment tools as a key indicator of health outcomes in patients with coronary heart disease (CHD) has grown significantly (Thompson & Yu, 2003). Several general questionnaires have been found to be applicable in assessing QOL in patients with coronary artery disease (CAD), particularly those that have been validated across different cultures. (Najafi et al., 2013). Below are some commonly used questionnaires in various studies to evaluate patients after revascularization procedures.

2.1.1. Kansas City Cardiomyopathy Questionnaire (KCCQ)

The KCCQ was created with input from both patients and clinicians to assess the various ways in which heart failure impacts patients' lives. The KCCQ utilizes a 2-week recall period, accounting for the daily fluctuations in heart failure symptoms, and consists of 23 items that correspond to seven key domains: symptom frequency, symptom burden, symptom stability, physical limitations, social limitations, quality of life, and self-efficacy (the patient's ability to manage their heart failure). The symptom frequency and symptom burden domains are combined into a total symptom score, which, when combined with the physical limitation domain, forms a clinical summary score that aligns with the key concepts of the NYHA functional class. Additionally, the symptom, physical limitation, social limitation, and quality of life domains can be aggregated to create an overall summary score. (Spertus et al., 2020)

2.1.2. Seattle Angina Questionnaire (SAQ)

The SAQ is a 19-item self-administered, disease-specific patient-reported outcome (PRO) measure that assesses five key domains: physical limitation, anginal stability, anginal frequency, treatment satisfaction, and disease perception/quality of life. The questionnaire was created through a review of the literature and interviews with both patients and healthcare providers to establish a conceptual framework reflecting the key symptoms of coronary artery disease (CAD) from the patient's perspective. Utilizing a 4-week recall period, the SAQ poses questions similar to those a cardiologist would ask during a clinical consultation. These include inquiries about the extent of physical limitation caused by angina, recent changes in symptoms, the frequency of angina episodes, the patient's satisfaction with their current treatment, and their perception of how angina affects their quality of life. Designed to be applicable across diverse demographics, including sex, race, and socioeconomic status, the SAQ was updated in 2014 to improve its feasibility in clinical settings. The revised version reduced the questionnaire to seven items, focusing on angina frequency, physical limitation, and quality of life, and introduced a summary score that averages these three domains. All domain scores, as well as the summary score, range from 0 to 100, with higher scores indicating less angina, fewer functional limitations, and better quality of life. (Thomas et al., 2021)

2.1.3. The World Health Organization Quality of Life Questionnaire (WHOQOL) BREF

The WHOQOL-BREF is one of the most widely recognized tools for cross-cultural assessment of quality of life (QOL), available in over 40 languages. It has been implemented in numerous countries, including the United States, the Netherlands, Poland, Bangladesh, Thailand, India, Australia, Japan, Croatia, Zimbabwe, and many others (Lin et al., 2017). This World Health Organization Quality of Life Questionnaire (WHOQOL)-BREF is a widely used general instrument for evaluating QOL in both healthy individuals and those with various medical conditions. The WHOQOL-BREF includes 26 items that assess four major domains: (1) physical health, (2) psychological health, (3) social relationships, and (4) environment. This shortened version of the original WHOQOL tool was developed to facilitate its use in large-scale research studies and clinical trials (Barolia et al., 2012)

2.2. Cardiac Biomarker

Cardiac biomarkers are naturally occurring substances that are released into the bloodstream when the heart muscle is injured or under stress. (Jacob & Khan, 2018) While these biomarkers are primarily used to diagnose, assess risk, and manage conditions like acute coronary syndrome (ACS) (Collinson, 2009), they can also serve as valuable indicators for evaluating cardiac events. Since these biomarkers are released in response to specific pathological processes, it can be assumed that treatments or interventions aimed at restoring heart function such as reperfusion therapies would reduce the levels of these biomarkers and in turn, improve patient outcomes. Previous studies have demonstrated the utility of cardiac biomarkers, such as NT-proBNP, in assessing the outcomes of percutaneous coronary intervention (PCI). However, to the best of the author's knowledge, no research has yet explored the use of cardiac biomarkers to evaluate outcomes following coronary artery bypass grafting (CABG). (Gupta et al., 2017)

2.3. SYNTAX Score

The SYNTAX score (Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery) is a scoring tool designed to assess the complexity of coronary artery disease. (Head et al., 2013) Based on the European Society of Cardiology (ESC) 2018 guidelines, several key factors are evaluated when calculating the SYNTAX score. These include the dominance of coronary arteries, the specific coronary segments affected by stenosis or occlusion, and the degree of stenosis or total occlusion. Each coronary segment is assigned a weight based on its location, with higher points for critical areas such as bifurcations and trifurcations. Additionally, factors such as the presence of total occlusions, the length and severity of lesions, and the degree of vessel tortuosity contribute to the score. Lesions in aorto-ostial areas, as well as the presence of thrombus or calcification, further impact the total score. The SYNTAX score also takes into account the involvement of smaller or diffusely diseased vessels, as these conditions are associated with more complex disease. (Neumann et al., 2018) Although the SYNTAX score is primarily used to evaluate the success of treatment for coronary lesions, it can also be utilized to predict patient prognosis following an intervention. A higher SYNTAX score, which indicates more complex disease, is demonstrated to represent a greater therapeutic challenge and is associated with a potentially worse prognosis. (Sianos et al., 2005.) Furthermore, the SYNTAX score can predict both all-cause mortality and cardiac-specific mortality rates. Using the SYNTAX score as a parameter to estimate the outcomes of an intervention can facilitate clinical decision-making and help guide treatment strategies. (Satheesh et al., 2024)

2.4. Major Adverse Cardiovascular Event (MACE)

The United States Food and Drug Administration (FDA), followed by the European Medicines Agency (EMA) in 2012, issued guidelines recommending the use of a three-point Major Adverse Cardiovascular Event (MACE) outcome, which includes acute myocardial infarction (AMI), stroke, and cardiovascular mortality, in all trials assessing the cardiovascular safety of diabetic medications. Some studies have also employed a four-point MACE outcome, adding hospitalization for unstable angina or revascularization procedures. The five-point MACE further expands this by incorporating heart failure (HF). (Bosco et al., 2021) The occurrence of MACE significantly impacts patient prognosis, making it a critical concern. Therefore, developing strategies to reduce or even prevent MACE after coronary revascularizaiton has been a longstanding clinical challenge. (Wang et al., 2022)

2.5. Clinical Adverse Event / Post-Operative Complication

Although the overall outcomes of coronary artery bypass grafting (CABG) have improved in recent years, the procedure still carries a risk of perioperative and postoperative mortality and morbidity. As a result, the incidence of morbidity and mortality following CABG is anticipated to rise, despite advancements in the procedure. Clinical adverse events, such as gastrointestinal bleeding and renal failure requiring dialysis, have been identified as common adverse event following CABG (Nalysnyk, 2003). in previous studies The incidence of several postoperative complications, including sternal wound infections, pneumonia, thromboembolic events, graft failure, atrial fibrillation, pulmonary hypertension, pericardial effusion, strokes, and hemodynamic instability, can also serve as important parameters for evaluating CABG outcomes. This is because a higher occurrence of clinical adverse events and postoperative complications can lead to significant morbidity and mortality. (Montrief et al., 2018)

3. Conclusion

Assessing the outcomes of coronary artery bypass grafting (CABG) involves a multifaceted approach, utilizing a range of parameters that reflect various aspects of patient health and recovery. Key measures such as Quality of Life (QoL), cardiac biomarkers, the SYNTAX score, Major Adverse Cardiovascular Events (MACE), and clinical adverse events provide essential insights into the effectiveness of the procedure and its impact on patient prognosis. Future research should continue to refine these parameters and explore additional predictive tools to optimize CABG outcomes, enhance patient care, and guide clinical decision-making.

Compliance with ethical standards

Disclosure of conflict of interest

The author declare no conflict of interest in relation to this review.

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