

CORONARY ARTERY DISEASE IN SINGLE VALVE REPLACEMENT VERSUS DOUBLE VALVE REPLACEMENT: A LITERATURE REVIEW

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Contribution

MB, AH conceived the idea, planned the study and drafted the manuscript. MASK and MID helped in literature review. All authors contributed significantly in manuscript submission.

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ABSTRACT

The prevalence of CAD in patients requiring valvular surgery is 20-40%. Clinically the patient is advised to receive surgery when the level of stenosis exceeds 50%. The aim of our study was to provide a complete picture of the prevalence and incidence of CAD in valvular surgery patients along with examining the mortality rates and causes of CAD within the same group of patients. A wide ranged literature search was conducted using PubMed, to find all the various published original articles comparing morbidity and mortality rates, along with the prevalence of CAD in valve surgery patients, as late as May 2015. Consequently, 3957 articles were found and then reviewed as part of the exclusion criteria, after which 10 studies were incorporated in our study. Out of which, 5 were based on incidence of CAD among AVR patients, 2 focused on CAD with MVR and remaining 3 indicated overall picture of CAD in DVR (dual valve replacement) patients. Our study suggests, an incident rate of CAD to be 30% in AVR patients, rates slightly higher in MVR patients but the least in DVR patients. However, the mortality rates for DVR patients were the greatest, the rates decreased among MVR patients and were the least among those receiving AVR.

Key Words: Aortic valve replacement, Incidence, Mortality, Coronary Artery Disease.

INTRODUCTION

Coronary artery disease (CAD), one of the leading causes of worldwide morbidity and mortality is caused by atherosclerosis of the coronary arteries, eventually leading to myocardial infarction. In 2013 CAD was the most common cause of death globally, resulting in 8.14 million deaths up from 5.74 million deaths in 1990.¹ CAD has been more commonly found in association with valvular heart disease, with degenerative causes being more frequent in the west, as compared to the rheumatic causes in the east. Rheumatic heart disease is caused by the body's response to untreated pharyngitis as a result of group A streptococci, it is a major health issue in under developed countries with an incidence rate of over 1 per 1000.² While the prevalence of degenerative factors increases with increasing age and degradation of cells.

The prevalence of CAD in patients requiring valvular surgery is 20-40%, with those in need of AVR far greater than those who require an MVR.³ CAD is more commonly seen among men and its risk factors include high blood pressure, hypercholesterolemia, smoking, poor diet, diabetes and obesity. Treatment involves measures to avoid risk factors and in addition some antiplatelet drugs such as aspirin and nitroglycerine. Clinically the patient is advised to receive surgery when and if the level of stenosis exceeds 50%. Therefore treatment via percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG) along with mitral valve replacement (MVR), aortic valve replacement (AVR) and dual valve replacement (DVR) are necessary surgical procedures.⁴

Several studies have shown that these surgical procedures have improved the morbidity and mortality rates, along with the patient's quality of life (QOL).⁵ Although the ideal treatment of choice is still up for debate, the most commonly practiced procedure involves valvular replacement along with CABG. A number of studies have shown that CABG improves long term morbidity and mortality rate while others show no significant differences between the procedures.^{6,7} CABG may also have adverse effects on the survival of patients with the valve replacement procedures, however the prominent cause for valve replacement was degenerative changes and the patient populations was mostly of an advanced age.⁸ At the same time QOL is also an important factor in deciding patient care and along with the medical procedures it can improve life expectancy as well.⁹

There have been a great number of studies comparing the morbidity and mortality rates after either CABG or angioplasty among patients with CAD. Whereas, studies focusing on morbidity and mortality to determine the choice of treatment are very few. At the same time, the number of studies relating the causes of CAD to their mortality rates are numbered as well. In addition there were no studies

addressing the prevalence of CAD in patients undergoing valve surgery in our part of the world. The aim of our study was to provide a complete picture of the prevalence and incidence of CAD in valvular surgery patients along with examining the mortality rates and causes of CAD within the same group of patients.

THE LITERATURE SEARCH

A wide ranged literature search was conducted using PubMed, to find all the various published original articles comparing morbidity and mortality rates, along with the prevalence of CAD in valve surgery patients, as late as May 2015. "morbidity and mortality in CAD patients", "PCI versus CABG mortality", "prevalence of CAD", "causes of CAD", "incidence of CAD in valvular surgery patients", "percutaneous coronary intervention versus coronary artery bypass surgery mortality and morbidity", "incidence of CAD" and different combinations of these very terms were used to find and trace a number of original articles. The lack of a wide range of resources, limited our search to the English language only. The list of references in all the retrieved articles was searched to identify any study missing from the database search.

STUDY SELECTION

3957 articles were found and then reviewed as part of the exclusion criteria. Studies were excluded for a number of reasons including, previous studies, studies carried out on animals or animal models, studies which were conducted without using a validated questionnaire to measure the morbidity and mortality rates among the patients requiring valvular surgery, duplicate publications, difficulty in extracting relevant data regarding the CAD from the study, and studies which did not use coronary artery bypass graft surgery as a technique. After deciding on the studies to be included, the data was extracted and verified. Considering the absolutely vast amount of data which was collected, no attempt was made to pool the data. The selected studies were then summarized in accordance to the specificity of the type of procedures being conducted for easy reviewing

CAD in single valvular surgery

Aortic Valve Replacement (AVR)

Out of the total of 3957 articles retrieved, 10 studies were incorporated in our study. From these 11 studies, 5 were focused solely on AVR.¹⁰⁻¹⁴ Out of these 5, 2 studies^{12,13} were exclusively focused on the incidence of CAD in patients undergoing AVR, which was estimated around 30%. The remaining three studies^{10,11} and 12] focused on the mortality rates among the similar groups of patients, which increased with increasing age and comorbidities. Ayaz et al. reported that a total of 31.9% of the patients who underwent AVR were identified with significant CAD. Similarly, Morrison et al. and

Exadactylos et al. recognized CAD in 30% and 34% of the patients operated on for AVR. Whereas, Zeynep et al. and Ottervanger et al. found the incidence of CAD to be much greater amongst their patients at 51.3% and 40% respectively.

Another important finding was the significant difference seen in the mortality rates of patients who underwent AVR and were associated with CAD, as presented by Jocelyn et al. The mortality rates of patients with isolated AS had the best outcome, when compared with those with AS + CAD, 97.6% vs. 98.7%, 91% vs. 94%, 83% vs. 90%, and 43% vs. 59% at 30 days, 1, 5, and 10 years, respectively. While those with CAD without myocardial damage had intermediate outcome depending on if they were propensity-matched isolated AS patients. Those with CAD, myocardial damage, and advanced comorbidities had the worst outcome, 93% vs. 89%, 78% vs. 67%, and 50% vs. 36% at 1, 5, and 10 years, respectively. Whereas, Theodore et al. and de Waard et al. compared the mortality rates of patients who underwent AVR and CABG with those who only received AVR. Theodore et al. found a mortality rate of 10.7% vs. 0% postoperatively and four late deaths in the AVR group. deWaard et al. found the 30-day follow-up mortality to be 3.0% in AVR-CABG patients and 2.0% in AVR patients. While the expected mortality as estimated by the logistic Euro-SCORE is 8.2% for patients in the AVR-CABG group and 6.6% for patients in the AVR group.

Overall, the incidence of CAD in AVR patients is considerably high, as well as the mortality rates which show a rise, alongside increasing age and development of risk factors for CAD which include, smoking, hypertension and diabetes more often seen in men.

Mitral Valve Replacement (MVR)

Similarly, 2 studies were found focusing on the incidence, mortality rates and causes of CAD amongst patients receiving MVR, with the incidence and mortality rates slightly higher as compared to the patients receiving AVR.^{15,16} At the same time, the incidence of significant CAD in MVR patients was found to be 32.9% as reported by Ayaz et al. A study conducted by Zeynep et al. also placed the incident rate of CAD at 35.2% among MVR patients. Whereas, studies by Morrison et al. and Huseyin et al. showed a substantial decrease in the incident rate from the mid 30's to 25% and 18.8% respectively.

Huseyin et al. in addition to reporting the incidence of CAD, also compared the presence of certain risk factors for CAD, among patients with and without CAD. Their findings demonstrated that patients with CAD had significantly increased prevalence of diabetes mellitus (14.6% vs. 4.5%; $p=0.02$), hypertension (36.6% vs. 16.4%; $p=0.003$), smoking (51.2% vs. 23.2%; $p=0.001$) and family history of CAD (39.5% vs. 20.0%; $p=0.01$) when compared to patients with normal coronary arteries. However, the

presence of dyslipidemia was similar in both groups (45.9% vs. 36.4%; $p=0.1$). On the other hand, Peter et al. discussed the mortality rates and various causes of CAD among their patients. About 45% of the patients' main cause for mitral regurgitation was ischemia, whereas the remaining 55% suffered from degenerative causes. In addition to the previously mentioned risk factors, they also took into consideration, an ejection fraction of less than 35% and three-vessel coronary artery disease. The 30-day mortality rate was 7.6% of which the ischemic group was 13% and the degenerative group 3%. The 5-year survival rates were 69%, while at 10-years it was 43% of which 33% were the ischemic group and 52% were degenerative.

The general incident rate of CAD in MVR patients is mostly high along with the mortality rate, both of which show a considerable upward trend with the passage of time. The various causes and risk factors of CAD are very similar in both groups of patients undergoing AVR and MVR.

CAD in dual valvular surgery (AVR + MVR)

Whereas, the remaining 3 studies were centred on the incidence and mortality rates of CAD amongst patients receiving dual valvular surgery, the incidence of which although being the least, had greater mortality rates than the other two procedures.¹⁷⁻¹⁹ The incidence rate of CAD in dual valvular surgery patients, was studied and reported by Ayaz et al. and Morrison et al. to be 25% and 20% respectively, lesser than the incident rate in either of the single valvular surgeries. Whereas, Tahereh et al. discussed the mortality rates among the DVR patients. The 30-day mortality rate was 7%, while the overall survival and cumulative incidence rate of cardiac death at 1 year was 80.2% and 10.9%; similarly at 4 years it was 73.7% and 15.8%. The causes for CAD in DVR patients, were again similar to the causes of CAD in both AVR and MVR patients.

LIMITATIONS

There are a number of limitations in our study that need to be considered. Firstly, using only a single database-PubMed and applying english language restriction may have resulted in some pertinent studies not being included. Secondly, there was significant diversity among the group of patients considered in our study. However, we feel that regardless of this variety, the general pattern is very straight forward as shown by our study.

CONCLUSION

In this study, a summarization of all the major studies in relation to the comparison between the incidence, causes, morbidity and mortality rates of CAD in valvular surgery patients. Our study suggests, an incident rate of 30% in AVR patients, slightly higher in MVR patients but the least in DVR patients. However, the mortality rates for DVR patients were the greatest, the rates decreased among MVR patients and

were the least among those receiving AVR. To conclude, there was a general increase in the incidence and mortality rates of CAD in patients, with the passage of time and greater exposure to the risk factors for CAD being the key causes.

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