Original Article

Early Detection Of Cardiac Risk And Its Relationship To Successful Outcome In Case Of Cardiac Intervention: A Comprehensive Review

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Abstract

Introduction: With around 31% mortality, cardiovascular diseases continue to be the major cause of death. Heart failure can be predicted early by evaluating risk factors such as hypertension, diabetes, obesity, and hypercholesterolemia. The predictors range from old age as a mild risk predictor to coronary artery syndrome as the major one.

Methodology: Studies were searched on electronic database such as Google scholar and PubMed. Patient data was extracted from the chosen studies. Study specifics (e.g., author, publication year, study design), Patient traits, including sample size, demographics, and clinical presentation, Identification of cardiac risk factors (using, for example, biomarkers, imaging methods, and clinical assessments) were extracted from the studies.

Results: Only full text articles that included risk stratification through Charlson comorbidity index (CCI) were included in the study. The result indicated that a higher CCI score will mean a negative outcome is predicted. The hazard ratio was stronger when adjusted for comorbid.

Conclusion: The quantitative impact of early detection of cardiac risk on the success rate of cardiac interventions is profound, underlining the critical need for public health initiatives promoting early screening and lifestyle modifications.

Keywords: Cardiac risk, early diagnosis, low risk, high risk, Outcomes.

Introduction

With around 31% of all deaths occurring globally, cardiovascular diseases (CVD) continue to be the major cause of death[1]. Early cardiac risk factor detection is essential for reducing this burden since it enables prompt therapies and perhaps better results. This article offers a quantitative evaluation of the association between early cardiac risk detection and the success rate of cardiac treatments.

Risk Factors: Over time, the prevalence of risk factors as hypertension, diabetes, obesity, and hypercholesterolemia has increased, greatly adding to the burden of CVD worldwide[2]. For instance, those who have hypertension are at an

increased risk of CVD by 2-3 times[3]. Additionally, diabetic patients have a twofold increased risk of CVD in comparison to those without the disease[4]. Alternatively, obesity increases risk by 60%[5].

Predictors of Increased Perioperative Cardiovascular Risk (Myocardial Infarction, Heart Failure, and Death) [6]: Major predictors are unsteady coronary syndromes, unstable or severe angina (Canadian class III or IV) with evidence of significant Ischemia risk from clinical symptoms or a noninvasive assessment. Uncompensated cardiac failure, significant arrhythmias, high-grade atrioventricular block, and other irregular heartbeats, symptomatic ventricular arrhythmias in the context of underlying cardiac disease ventricular rate irregularities in supraventricular arrhythmias and severe valve disease. Intermediate risk factors include (Canadian class I or II) mild angina pectoris, history of myocardial infarction or abnormal Q waves, previous or compensated heart failure, Diabetes Mellitus (DM), particularly insulin-dependent diabetes and insufficient kidney function. Old age, anomalies in the ST-T waveform, and left ventricular hypertrophy on the electrocardiogram, a rhythm different than sinus, such as atrial fibrillation, low functional capacity, such as being unable to ascend one flight of stairs while carrying a bag of groceries, prior stroke history and systemic hypertension not under control are the milder ones[6].

Early Detection and Prevention: Since these risk factors have a direct impact on the initiation and development of CVD, the American Heart Association (AHA) emphasizes the significance of early diagnosis of these risk factors. There is data to support the idea that the risk of having heart disease decreases by 2% for every 1% decrease in cholesterol levels[7]. The risk of stroke and coronary heart disease can both be reduced by 41% and 22%, respectively, with a blood pressure reduction of 10 mmHg [8].

These hazards can be greatly reduced by taking preventive actions including making lifestyle modifications. As a matter of fact, a study found that adopting a healthier lifestyle—one that includes regular exercise, a well-balanced diet, and quitting smoking—can reduce the risk of heart disease by 80%[9].

Cardiac Interventions and Outcomes: Early risk factor identification is directly related to good cardiac intervention outcomes. A lower incidence of problems following surgery was observed in individuals having coronary artery bypass grafting (CABG) when risk factors such hypertension and hypercholesterolemia were identified early and then controlled[10]. In a similar manner, patients who received percutaneous coronary intervention (PCI) fared much better than those whose diabetes was not adequately controlled[11]. Acute coronary syndrome patients' mortality rates are reduced by 35% when diagnosed and treated early, compared to when they receive late therapies, according to recent research[12]. Additionally, individuals with heart failure who received early care experienced a 56% decrease in their probability of returning to the hospital[13].

Methodology

Research question for this study was: “How does the efficacy of cardiac interventions relate to the early identification of cardiac risk factors?”

Literature Search: To locate research pertaining to the early identification of cardiac risk factors and their influence on the results of cardiac interventions, a comprehensive search of pertinent literature is done. We used electronic resources like Cochrane Library, Embase, and PubMed. A combination of keywords and Medical Subject Headings (MeSH) terminology is used to provide a thorough search. Every pertinent publication up to the date of the search is included in the search strategy.

Study Selection: To determine which research should be reviewed, inclusion and exclusion criteria are developed. Researches that are presented in peer-reviewed publications, research on the early identification of cardiac risk factors, studies that detail the results of cardiac interventions and investigations that clearly characterize cardiac risk factors and have a defined therapeutic procedure were included in the study. Exclusion criteria were outlined to omit studies with insufficient data or alignment with the research objectives.

Patient data was extracted from the chosen studies. Study specifics (e.g., author, publication year, study design), Patient traits, including sample size, demographics, and clinical presentation, Identification of cardiac risk factors (using, for example, biomarkers, imaging methods, and clinical assessments) were extracted from the studies.

The Charlson comorbidity index (CCI): The Charlson comorbidity index (CCI) is a rating system that estimates a patient's mortality based on a number of possible concurrent diseases (comorbidities), including cancer, AIDS, and

heart disease. According to the risk of death linked to each ailment, a score of 1, 2, 3, or 6 is given to that condition. More points are awarded to patients who are 50 years or older. The sum of the scores yields a final score that can be used to estimate mortality. Using the International Classification of Diseases (ICD) diagnosis codes frequently used in patient records, the CCI can be recognized. Charlson comorbidity index (CCI): CCI-0 (control), CCI-1, CCI-2, CCI-3 is used in previous studies to divide patients into several risk groups[14].

Following are the details for each category and score

1. Myocardial Infarction (MI) +1
2. Congestive Cardiac Failure (CCF) +1
3. Peripheral Vascular Disease +1
4. Ischemia +1
5. Rheumatic disease +1
6. Pulmonary Disease +1
7. GIT ulcer +1
8. Age
9. 50 to 59 years old: +1
10. 60 to 69 years of age: +2
11. Age range: 70 to 79: +3
12. 80 years of age or older: +4

1. Controlled diabetes +1
2. Uncontrolled diabetes +2
3. Mild Hepatic illness +1
4. Moderate/severe hepatic illness +3
5. Hemiplegia or paraplegia +2
6. Renal disease +2
7. Cancer (localized) +2
8. Metastatic cancer +6
9. Leukemia +2
10. Lymphoma +2
11. AIDS +6
12. Dementia +1

Results

Based on their overall score, the CCI can be used to divide patients into several risk groups. A CCI of 0 for instance, indicates no comorbidities and a low risk of mortality; a CCI of 1 for one mild comorbidity and a slightly increased risk of mortality; a CCI of 2 for two mild comorbidities or one moderate comorbidity and a moderate risk of mortality; and a CCI of 3 or more for multiple comorbidities or at least one severe comorbidity and a high risk of mortality[13].

Table: Characteristics of the studies included

Study ID	Year	Sample Size	Mean Age	Males	Main Finding	Risk Factors	CCI-score and Risk stratification
Núñez 2004[15]	Prospective cohort study; 2000-2003; Spain	1035 AMI (508 STEMI, 527 NSTEMI)	68 ± 3	67.9%	AMI Hospitalized	Present	Present
Ramirez-Marrero 2011[16]	Prospective cohort study; 2004-2005; Spain	715 NSTEACS	66.2 ± 11.2	NA	Hospitalized for NSTEACS	Present	Present
Radova-novic 2014[17]	Prospective cohort study; 2002-2012; Swiss	29, 620 ACS	66.3 ± 12.8	73%	ACS	Present	Present
Pastor 2019[18]	Prospective cohort study; no study period found; Spain	520 ACS	84.4 ± 3.6	61.5%	Hospitalized for NSTEACS	Present	Present

Zhang 2020[19]	Retrospective cross-sectional study; 2004-2014; US	6, 613, 623 ACS	67 (56-79)	60%	ACS	Present	Present
Hautamäki 2020[20]	Retrospect cohort study; 2015-2016; Finland	1576 ACS	69.3 ± 11.8	69.1%	ACS	Present	Present

The CCI scores were used to estimate the likelihood that events like mortality, recurrent myocardial infarction (MI), and other unfavorable cardiac events would occur.

The search for electronic data resulted in a number of studies. Only full text articles that included risk stratification through Charlson Comorbidity Index (CCI) were included in the study. The result indicated that a higher CCI score will mean a negative outcome is predicted.

All of these studies measured the risk of adverse outcomes on basis of CCI scores. A total of 6.65 million population sample was evaluated through these studies (main characteristics are given in the table).

There were 4 prospective cohorts and two retrospective cohorts. Main diagnosis in most of studies was chronic artery syndrome (ACS) with a male proportion more than females. All of these studies measured CCI scores on basis of presence of a predictor or a risk factor. Hazard ratios have shown that the chance of negative outcomes is increased by the presence of comorbid conditions.

Discussion

The prognosis at 30 days and a year following an acute myocardial infarction (AMI) was predicted using the Charlson comorbidity score in the study. The CCI score was used to assess how comorbid conditions affected the result. The Charlson comorbidity index and various outcomes after an AMI were compared by the researchers. Interest-generating results included prognostic factors at 30 days and a year following the AMI. The findings showed that having a comorbid condition greatly affects the prognosis[15].

Charlson index's value was used in risk stratification for patients with acute coronary syndrome (ACS) who were admitted without ST-segment elevation. The individuals with ACS in the study were those whose electrocardiograms did not show ST-segment elevation. In this patient cohort, the researchers looked into the connection between the Charlson index and risk stratification. The correlation between the Charlson index scores and the clinical outcomes was the outcome of interest. The results imply that utilizing the Charlson score to take into account comorbidities can offer useful information for determining the severity of ACS and forecasting outcomes in this particular patient population. Comorbid conditions increased the likelihood of a negative prognosis[16].

The researchers used information from the national AMIS plus registry for the years 2002 through 2012. CCI scoring system was used to assess the comorbidity burden. In ACS patients, the researchers evaluated different outcomes using this. The prognosis was evaluated in terms of hospital stay, death and recurrent cardiac complications during the stay. According to the study findings, the prognosis of the patients who were hospitalized for ACS was correctly predicted[17]. Another research proposed that demographic and pre-operative clinical factors can be used to determine the prognosis of the surgery [18].

The researchers looked at information from a group of patients who had ACS to determine the burden of comorbid conditions that can result in adverse outcomes in case of cardiac intervention using CCI scores. The evaluation of the relationship between CCI scores and various facets of patient management and outcomes was done in this study. Treatment modalities, pharmaceutical usage, in-hospital complications, and mortality rates were among the outcomes of interest. CCI score were used to determine the outcome and design specific treatment regime[19]. This emphasized the importance of patient assessment and determining prognosis prior to the intervention which then can lead to better patient management.

The MADDEC study was carried out by Hautamäki et al. (2020) to investigate the relationship between mortality in patients with acute coronary syndrome and the Charlson Comorbidity Index. The study discovered a strong correlation between higher index scores and greater mortality rates[20].

Using electronic health information, Ng et al. (2016) concentrated on the early diagnosis of heart failure. Heart failure (HF) is 20% more likely to occur in people over the age of 40 than it is in younger people. Late diagnosis is linked to a high rate of impairment, medical expenses, and mortality (i.e. 50% within 5 years after diagnosis). Early identification of HF creates the opportunity to try heart function preservation techniques and alter the course of the disease's natural history[21].

Accurate and quick diagnostic technologies are necessary for early cardiac risk diagnosis. Most often employed diagnostic modalities, such as electrocardiography (ECG), echocardiography, cardiac computed tomography, magnetic resonance imaging, and cardiac biomarkers, such as troponins and B-type natriuretic peptide tests all should be used to determine the risk of an adverse cardiac event in case of surgical intervention. Early identification and risk assessment are essential to the medical management of cardiovascular illnesses.

Risk assessment for cardiovascular disease (CVD) is a screening technique that calculates the likelihood of experiencing a CVD event within a certain time frame, often 10 years. It asks questions regarding a number of risk factors, including age, sex, blood pressure, smoking, cholesterol, diabetes, obesity, and physical inactivity. Some risk assessment instruments employ equations based on the Framingham Risk Score or the Pooled Cohort Equations. Other instruments utilize assays to assess the degree of inflammation (hsCRP) or the existence of peripheral artery disease (ABI). Risk assessment can be improved by taking into account risk-increasing variables (like lipoprotein or subclinical atherosclerosis testing (like coronary artery calcium (CAC)). Risk assessment assists in adjusting the intensity of therapy to prevent CVD in asymptomatic persons.

Conclusion

The quantitative impact of early detection of cardiac risk on the success rate of cardiac interventions is profound, underlining the critical need for public health initiatives promoting early screening and lifestyle modifications. Enhancing early detection strategies, effectively managing risk factors, and timely cardiac interventions are key components in reducing the global burden of CVD, improving patient outcomes, and ultimately saving lives.

References:

1. World Health Organization. (2021). Cardiovascular Diseases (CVDs). Available at: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)
2. World Health Organization. (2021). Risk Factors. Available at: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_2
3. Ettehad D, et al. (2016). Blood pressure lowering for prevention of cardiovascular disease and death: a systematic review and meta-analysis. The Lancet, 387(10022), 957–967. https://doi.org/10.1016/S0140-6736(15)01225-8
4. Emerging Risk Factors Collaboration. (2010). Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. The Lancet, 375(9733), 2215–2222. Available at: https://doi.org/10.1016/S0140-6736(10)60484-9
5. Eckel RH, et al. (2013). 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 129(25 Suppl 2):S76-99. Available at: https://doi.org/10.1161/01.cir.0000437740.48606.d1
6. Eagle KA, Berger PB, Calkins H, Chaitman BR, Ewy GA, et al. ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery—Executive Summary A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1996 Guideli. Circulation [Internet]. 2002 Mar 12;105(10):1257–67. Available from: https://doi.org/10.1161/circ.105.10.1257
7. Cholesterol Treatment Trialists' (CTT) Collaborators. (2012). The effects of lowering LDL cholesterol with statin therapy in people at low risk of vascular disease: meta-analysis of individual data from 27 randomised trials. The Lancet, 380(9841), 581–590. Available at: https://doi.org/10.1016/S0140-6736(12)60367-5
8. Rapsomaniki E, et al. (2014). Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1·25 million people. The Lancet, 383(9932), 1899–1911. Available at: https://doi.org/10.1016/S0140-6736(14)60685-1

9. Chiuve SE, et al. (2008). Healthy lifestyle factors in the primary prevention of coronary heart disease among men: benefits among users and nonusers of lipid-lowering and antihypertensive medications. Circulation, 118(1), 98–105. Available at: https://doi.org/10.1161/CIRCULATIONAHA.108.783738
10. Benedetto U, et al. (2018). Off-Pump Versus On-Pump Coronary Artery Bypass Grafting: Insights From the Arterial Revascularization Trial. Journal of the American Heart Association, 7(13), e008791. Available at: https://doi.org/10.1161/JAHA.118.008791
11. Eindhoven DC, et al. (2018). Diabetes Mellitus and Clinical Outcomes After Percutaneous Coronary Intervention: The "Sweet Spot" of Glycemic Control. Journal of the American Heart Association, 7(15), e008965. Available at: https://doi.org/10.1161/JAHA.118.008965
12. Mehta SR, et al. (2016). Early versus delayed invasive intervention in acute coronary syndromes. The New England Journal of Medicine, 360(21), 2165–2175. Available at: https://doi.org/10.1056/NEJMoa0807986
13. Yancy CW, et al. (2013). 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Journal of the American College of Cardiology, 62(16), e147–e239. Available at: https://doi.org/10.1016/j.jacc.2013.05.019
14. Charlson, M. E., Carrozzino, D., Guidi, J., & Patierno, C. (2022). Charlson Comorbidity Index: A Critical Review of Clinimetric Properties. Psychotherapy and psychosomatics, 91(1), 8–35. https://doi.org/10.1159/000521288
15. Núñez, J. E., Núñez, E., Fácila, L., Bertomeu, V., Llàcer, A., Bodí, V., Sanchis, J., Sanjuán, R., Blasco, M. L., Consuegra, L., Martínez, A., & Chorro, F. J. (2004). Papel del índice de Charlson en el pronóstico a 30 días y 1 año tras un infarto agudo de miocardio [Prognostic value of Charlson comorbidity index at 30 days and 1 year after acute myocardial infarction]. Revista espanola de cardiologia, 57(9), 842–849.
16. Ramirez-Marrero MA, Jimenez-Navarro M, De Teresa-Galvan E, De Mora-Martin M. The importance of the Charlson index in risk stratification in patients admitted for acute coronary syndrome without ST-segment elevation. Eur J Cardiovasc Prev Rehabil. 2011; 18(Suppl 1): S113.
17. Radovanovic D, Seifert B, Urban P, et al. Validity of Charlson Comorbidity Index in patients hospitalised with acute coronary syndrome. Insights from the nationwide AMIS Plus registry 2002–2012. Heart. 2014; 100: 288- 294. https://doi.org/10.1136/heartjnl-2013-304588
18. Esteve Pastor MA, Martin E, Alegre O, et al. Relationship of Charlson Comorbidity Index with adverse events in elderly patients with Acute Coronary Syndromes: an analysis from LONGEVO-SCA Registry. Eur Heart J. 2019 Oct; 40: 1488.
19. Zhang F, Bharadwaj A, Mohamed MO, Ensor J, Peat G, Mamas MA. Impact of Charlson co-morbidity index score on management and outcomes after acute coronary syndrome. Am J Cardiol. 2020; 130: 15- 23.
20. Hautamäki M, Lyytikäinen L-P, Mahdiani S, et al. The association between charlson comorbidity index and mortality in acute coronary syndrome-the MADDEC study. Scand Cardiovasc J. 2020; **54**: 146- 152
21. Kenney Ng, Steven R. Steinhubl, Christopher deFilippi, Sanjoy Dey, Walter F. Stewart, Early Detection of Heart Failure Using Electronic Health Records,Practical Implications for Time Before Diagnosis, Data Diversity, Data Quantity, and Data Density, Circulation: Cardiovascular Quality and Outcomes. 2016;9:649–658, https://doi.org/10.1161/CIRCOUTCOMES.116.002797