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Systematic Review

Comparison of complications associated with conservative and surgical treatment for stable cases of coronary artery disease: meta-analysis and systematic review

Waleed A. Hedar[1], Emad A. Alsaedi[2]*, Asim A. Almohammadi[2], Mohammed N. Almarwani[3], Sondos Almadhlouh[4], Walaa M. Alsharif[2], Majed H. Alsaedi[5], Khaled H. Alnhas[2], Yazeed N. Alaufi[2], Nasser N. Alsuhaymi[2], Abdulaziz H. Alraddadi[2], Mahmood A. Kurdi[2], Abdualrhman O. Alahmadi[2], Suhail A. Alshabi[2], Mohammed Z. Alhawsawi[6]

[1]Department of Cardiology, King Salman Medical City, Madinah, Saudi Arabia
[2]Faculty of Medicine, Al-Rayan Colleges, Madinah, Saudi Arabia
[3]Pharmaceutical Care Services, Prince Muhammad Bin Abdulaziz Hospital, Ministry of National Guard Health Affairs, Madinah, Saudi Arabia
[4]Department of Pediatrics, Ohud Hospital, Madinah, Saudi Arabia
[5]Department of Pharmacy, King Salman Bin Abdulaziz Medical City, Madinah, Saudi Arabia
[6]Department of Internal Medicine, King Salman Bin Abdulaziz Medical City, Madinah, Saudi Arabia

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***Correspondence:**
Dr. Emad A. Alsaedi,
E-mail: emadd862@gmail.com

ABSTRACT

Coronary artery disease (CAD) is a severe public health issue. Genetic, environmental, and lifestyle factors affect the development of coronary artery disease. There are several medicinal and interventional treatments offered to treat CAD. This study aimed to compare the complications associated with conservative and surgical treatments of CAD. Data was taken from PubMed, where 679 clinic trials and randomised control trials were chosen after adding filters and 25 studies were added by hand search. Articles were then analysed, and only ten studies were taken for meta-analysis. A total of 41025 patients were added to these studies, out of which 12077 were treated surgically and 28948 were treated by conservative management either by monotherapy or combined medicinal therapy. Further, the meta-analysis done with the help of Revman concluded that 6% (CI 0.00–16.8%) complication cases were reported in conservative treatment and 2% (CI 0.00–23%) in surgical treatment, where the I^2 was 100%. Considering the treatments separately, 901 patients given monotherapy and 354 given combined medicinal therapy were reported to have complications. As per the surgical treatments, 509 cases were reported when treated by SAG, and MAG, 216 with PCI, and CABG, 40 when treated by EVH and OVH, and 10 patients faced complications when treated with angioplasty, reported to suffer complications after treatment. So, the surgical treatments, as per this review, have been proven to have less complications than conservative treatment.

Keywords: CAD, Surgical treatment, Complications, Conservational treatment, Post-treatment complications

INTRODUCTION

Coronary artery disease (CAD) is a leading cause of death in people around the globe. According to one study, heart disease is the primary cause of death in dialysis patients, accounting for 44% of all-cause mortality. Acute myocardial infarction (AMI) accounts for around 20% of all cardiac fatalities.

Maintenance dialysis patients have a 10-20-fold increase in age-adjusted cardiovascular mortality compared to individuals without chronic kidney disease (CKD). Despite the significant mortality risk of CAD in patients on maintenance dialysis, the ideal therapeutic method is unknown, and the debate remains on whether revascularisation therapy is preferable to conservative MT.[1]

The prognosis of patients with coronary artery disease varies greatly and is mainly determined by ventricular function. The research is unclear if an invasive method of myocardial revascularisation is superior to a conservative strategy of optimised medical therapy regarding the critical outcomes of death and myocardial infarction. Furthermore, except for individuals with left main coronary artery disease, this consistency in prognosis exists across diverse patient groupings. Despite their anatomical complexity, the initial research on the evolution of individuals with CAD and retained left systolic ventricular function revealed a low incidence of severe cardiac events, mortality, or myocardial infarction in non-revascularized patients. Furthermore, in preserved systolic ventricular function, retrospective studies comparing optimised medical therapy (OMT) alone with coronary artery bypass surgery (CABG) revealed similar death or myocardial infarction (MI) rates in patients with single-vessel or multivessel disease. For ethical considerations, observing the natural course of CAD patients in epidemiological research is impossible. Even if patients avoid coronary procedures, they will still receive medical therapy and lifestyle modification advice, resulting in changes in their clinical development. As a result, the progression of CAD patients may be detected in prospective trials, particularly in randomised groups that include patients receiving only medicinal therapy.

Conservative CAD treatment aims to slow the course of atherosclerosis, alleviate symptoms, and prevent atherothrombotic events. This entails combining lifestyle changes like exercise and diet with medicinal therapy. The cornerstone of CAD treatment is medical therapy.[2] It is typically a mix of anti-ischemic medications (mainly beta-blockers or calcium-channel inhibitors, as well as nitrates) and pharmaceuticals that prevent atherothrombotic events and regulate cardiovascular risk factors. Antiplatelet therapy with acetylsalicylic acid (ASA) or clopidogrel, statin therapy, lipid-lowering medicines, and the injection of renin-angiotensin-aldosterone system (RAAS) inhibitors are examples of the latter. The ultimate pharmaceutical option must be personalised to the particular patient. Antithrombotic and cholesterol-lowering therapies have been linked to increased survival.[3]

Statins have been shown to reduce total mortality by 13% in individuals with underlying cardiovascular disease, and ASA has been shown to minimise the risk by 10% every year in patients following a myocardial infarction, stroke, or transient ischemic attack.[4] This impact can also be seen in patients who have had CABG. Medical therapy is used in conjunction with bypass surgery and is regarded as the primary pillar in the care of CABG patients. This organisation emphasises the importance of cross-disciplinary teamwork among surgeons, cardiologists, and primary care physicians. The same applies to percutaneous coronary intervention (PCI), where temporary dual platelet inhibition is required to prevent stent thrombosis.

The primary goal of anti-ischemic treatment is to control symptoms and improve quality of life. Predicting the number of patients for whom medical therapy does not provide appropriate symptom control is impossible. Clinical and observational data suggest that the majority of individuals with chronic CAD have no, or only a few, irregular symptoms.[5]

When symptoms occur, the coronary artery has substantial stenosis and calcification, which raises the challenges and hazards of surgery, particularly PCI. As a result of perioperative difficulties and bleeding events, these high-risk patients in our clinical practice are undertreated with revascularisation therapy.

Furthermore, no clear recommendations exist for managing and treating such groups. Although some prior observational studies supported revascularisation, a recent RCT, the Ischemia-CKD research, found that revascularization therapy was less successful than conservative MT for end-stage renal disease (ESRD) with stable CAD.[6]

Objective

This study is planned to compare the complications of conservational and surgical treatments of CAD.

METHODS

The preferred reporting items for systematic reviews and meta-analyses extension for scoping review (PRISMA-ScR) criteria were used during this systematic review (Table 1). The protocol of the study was registered at PROSPERO with registration ID CRD42023486182.

Eligibility criteria

The randomised control trials and case studies in English from January 2012 to September 2023 were evaluated. The topic to be assessed was the type of treatments for CAD and their comparison. The search was based on keywords such as CAD, coronary artery disease, conservative treatment, surgical treatment, and complications.

Data source

This study's data was taken from the Pubmed databases. The researcher examined textbooks, review papers, and bibliographies of retrieved articles. The retrieved studies were checked for data that might be redundant or overlapping.

Search strategy

On Pubmed, the search was made using keywords such as coronary artery disease, treatment and complications. It gave a result of 44637 articles; further, the filters were used; the duration was lessened only from 2012 till 2023, so 17147 pieces were left. In article type, only clinical studies and randomised control trials were taken under investigation; there were only 1398 studies. Only the complete free-text studies, published in English and done on humans, were considered. Resulting in 679 articles, and 25 papers were later added from a hand search. The CSV file was downloaded from Pubmed. The filters and database chosen are shown in (Figure 1).

Study selection

The researcher included a study that stressed the treatment of coronary artery disease, only studies with human samples were considered, and studies were only selected if they had data regarding the complications and adversities patients faced post-treatment to make a comparison.

RESULTS

Literature search

In the first search, 679 articles were retrieved, and 25 studies were chosen by hand. Following the elimination of duplicates and the ineligibility of studies by Abstrackr, 534 publications' titles and abstracts were examined, and 194 studies' whole texts had their eligibility evaluated. Then, 40 articles were further analysed, and 10 studies were included in the review. Data is shown in Figure 2.

Characteristics of included studies

Based on the inclusion criteria, only a few studies were added to the review. The ten included studies were then thoroughly studied to examine the characteristics of studies summarised in Table 2.

Overview of the treatments used for CAD

Ten randomised trials were included in the current study, with a total sample size of 41025 individuals (n=41025). There were 3846 patients treated by angioplasty; 228 went through open vein harvesting and endoscopic vein harvesting; 2215 had single or multiple artery grafting; 5788 went through CABG, and PCI; 1553 patients were given rivaroxaban (monotherapy), and 27395 patients were treated with combined conservative treatment. The types of surgical and conservative treatments taken under study are summarised in Table 3.

The complications associated with the type of treatment

Patients can suffer from multiple complications as a result of coronary artery disease treatments. This study classified the treatments into two categories: conservative treatment based on medicines and surgical treatments. The major complications highlighted in the ten trials under investigation are death, stroke, myocardial infarction, hematoma, lymphorrhea, paresthesia and arrhythmias.

The trials were studied, and the data was extracted as per the complications in the CAD patients treated with different types of treatments. As per the trials under study, there were 901 patients reported to have complications while following the mono-therapy and 354 with combined therapy of different conservative medicines. Further, for the surgical treatments, it had been seen that 509 cases were reported when treated by single arterial graft (SAG) and multiple arterial grafts (MAG), 216 with PCI, and CABG, 40 when treated by EVH and OVH, and 10 patients faced complications when treated with Angioplasty. Data is summarised in Table 4. The conclusion cannot be drawn based on the number of cases reported per the treatments, as the sample under each study differed.

The outcome of the conservation treatment provided to CAD patients

The meta-analysis of the complications faced by patients on conservative treatment was done using Revman; five studies discussed the complications, the total event of complications and the number of patients in a study are summarised in Table 5. The pooled proportion of patients who experienced complication by conservative treatment was 6% (CI 0.00–16.8%). Heterogeneity found was considerable heterogeneity I^2=100%. A forest plot of meta-analysis results is provided in Figure 3.

The outcomes of surgical treatment provided to CAD patients

There were seven studies for the meta-analysis of the complications faced by patients on surgical treatment. The total event of complications and number of patients in a study are summarised in Table 4. Pooled proportion of patients who experienced complications by surgical treatment was 2% (CI 0.00–23%). Heterogeneity found was considerable heterogeneity I^2=100%. A forest plot of meta-analysis results is provided in Figure 4.

Table 1: PRISMA systematic review flowchart.

Section/topic		Checklist item	Yes/no
Title			
Title	1	Identify the report as a systematic review, meta-analysis, or both	Yes
Abstract			
Structured summary	2	Provide a structured summary (IMRAD) including, as applicable: introduction (objectives); methods; (study eligibility criteria, participants, and interventions;	Yes

Continued.

Section/topic		Checklist item	Yes/no
		study appraisal and synthesis methods); results; discussion (limitations, conclusions and implications of key findings) systematic review registration number (PROSPERO)	
Introduction			
Rationale	3	Describe the rationale for the review in the context of what is already known	Yes
Objectives	4	Provide an explicit statement of questions being addressed concerning participants, interventions, comparisons, outcomes, and study design (PICOS)	Yes
Methods			
Protocol and registration	5a	Indicate if a review protocol exists, if and where it can be accessed (PROSPERO), registration IDCRD42023486182	Yes
	5b	Registration on PROSPERO (preferable)	Yes
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale	Yes
Information sources	7	Describe all information sources (e.g., databases with coverage dates, contact with study authors to identify additional studies) in the search and date last searched	Yes
Search	8	Present complete electronic search strategy for at least one database, including any limits used, so it could be repeated	Yes
Study selection	9	State the process for selecting studies (i.e., screening, eligibility – inclusion/exclusion criteria, included in systematic review, and, if applicable, included in the meta-analysis)	Yes
Data collection process	10	Describe data extraction method from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming investigator data	Yes
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made	Yes
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information will be used in any data synthesis	N/A
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	Yes
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis (only for meta-analysis study)	Yes
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies)	No
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. (only for meta-analysis study)	Yes
Results			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	Yes
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations	Yes
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12) (only for meta-analysis study)	N/A
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: simple summary data for each intervention group, effect estimates and confidence intervals, ideally with a forest plot (only for meta-analysis study)	Yes
Synthesis of results	21	Present results of each meta-analysis, including confidence intervals and consistency measures (only for meta-analysis study)	Yes
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15) (only if meta-analysis was performed)	No
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see item 16]) (only for meta-analysis study)	Yes

Continued.

Section/topic		Checklist item	Yes/no
Discussion			
Summary of evidence	24a	Summarize the main findings including the strength of evidence for each primary outcome; consider their relevance to critical groups (e.g., healthcare providers, users, and policy makers)	Yes
	24b	Reporting the conflicting findings (from literature) and putting forth new ideas and new research directions	Yes
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias)	Yes
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research	Yes
Citations	27	To cite from recent literature in the articles	Yes
Funding			
Funding	28	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the periodic review and the grant number	Yes

Table 2: Characteristics of the trials under review.

Author	Year	Journal	Sample size	Age (years)	Study type	Treatment	Data assessment
Ganyukov et al[7]	2020	Journal of Interventional Cardiology	155	≥60	Randomised control trial	PCI or CABG or HCR	For the primary endpoint, RI differences between the study arms (with CABG taken as reference) were tested against a prespecified noninferiority margin of 4.2
Rittger et al[8]	2012	Catheterization and Cardiovascular Interventions	1,001	>75	Retrospecti-ve study	PCI, stent implant or conventional treatment	ANOVA, e t-test, the Kruskal-Wallis test, Chi Square -test
Eikelboom et al[9]	2019	Journal of American College of Cardiology	27,395	≥18	Randomised control trial	Rivaroxaban and aspirin	stratified log-rank test.
Cherniavsky et al[10]	2015	Journal of Cardiothoracic Surgery	228	≥18	Randomised control trial	Endoscopic and open methods of vein harvesting for coronary artery bypass grafting	Spearman ratio of rank correlation
Sondagur et al[11]	2014	Journal of Invasive Cardiology	2845	≥60	Randomized control trial	CAG or PCI	Descriptive analysis
Naito et al[12]	2022	JAMA cardiology	2215	≥20	Randomised clinical trial	Rivaroxaban monotherapy versus combination therapy with antiplatelets	Cox proportional hazards regression model
Alam et al[13]	2017	Journal of cardiothoracic surgery	87	<65	Randomised clinical trial	Elective CABG surgery	Kruskal-Wallis
Rezende et al[14]	2013	The Journal of thoracic and cardiovascular surgery	611	≥60	Randomised clinical trial	Surgery, angioplasty or medication	Multivariate analysis by Cox regression

Continued.

Author	Year	Journal	Sample size	Age (years)	Study type	Treatment	Data assessment
Investigators[15]	2018	The new England journal of medicine	5022	≥60	Randomised clinical trial	Rivaroxaban	Cox models, and Kaplan–Meier
Thuijs et al[16]	2021	European Journal of Cardio-Thoracic Surgery	1466	>60	Randomised clinical trial	CABG	Wilcoxon rank-sum, Chi-square test, descriptive analysis

Table 3: The prevalence of treatments provided to patients, n (%).

Treatments	Frequency (%)
Surgical treatment	
Angioplasty	3846 (9.37)
Open vein harvesting (OVH) and endoscopic vein harvesting (EVH)	228 (0.56)
Single or multiple grafting	2215 (5.39)
CABG and PCI	5788 (14.11)
Conservational treatment	
Monotherapy	1553 (3.79)
Combined conservational therapy	27395 (66.78)
Total	41025 (100)

Table 4: The prevalence of complications faced by patients after certain treatments, n (%).

Prevalence of complications	Frequency (%)
Surgical treatment	
Angioplasty	10 (0.49)
Open vein harvesting (OVH) and endoscopic vein harvesting (EVH)	40 (1.97)
Single or multiple grafting	509 (25.07)
CABG and PCI	216 (10.65)
Conservational treatment	
Monotherapy	901 (44.38)
Combined conservational therapy	354 (17.44)
Total	2030 (100)

Table 5: Analysis of the conservative treatments provided to patients and onset of associated complications.

Study or subgroup	Complication		No complications		Odd ratio	
	Events	Total	Events	Total	Weight (%)	M.H, random, 95% CI
Eikelboom 2019	458	18278	17820	18278	20.1	0.00 [0.00,0.00]
Naito 2022	348	2215	1867	2215	20.1	0.03 [0.03,0.04]
Rezende 2013	27	68	41	68	19.9	0.43 [0.22,0.06]
Rittger 2012	35	225	190	225	20	0.03 [0.02,0.06]
Zannad 2018	381	626	245	626	20	2.42 [1.93,3.03]
Total (95% CI)		21412		21412	100	0.06 [0.00,1.68]
Total events	1249		201163			

Heterogeneity, tau^2=14.34, Chi^2=4338.76, df=4 (p<0.00001), I^2=100%, test for overall effect z=1.65 (p=0.10)

Table 6: Analysis of the surgical treatments provided to CAD patients and onset of associated complications.

Study or subgroup	Complication		No complications		Odd ratio	
	Events	Total	Events	Total	Weight (%)	M.H, random, 95% CI
Alam 2017	18	86	68	86	14.2	0.07 [0.03,0.15]
Chemyavskiy 2015	64	228	164	228	14.3	0.15 [0.10,0.23]
Ganyulov 2020	73	1584	1511	1584	14.3	0.00 [0.00,0.00]
Rezende 2013	67	132	65	132	14.3	1.06 [0.66, 1.72]
Rittge 2012	27	776	749	776	14.3	0.00 [0.00,0.00]

Continued.

Study or subgroup	Complication		No complications		Odd ratio	
	Events	Total	Events	Total	Weight (%)	M.H, random, 95% CI
Sondagur 2014	34	1416	1382	1416	14.3	0.00 [0.00,0.00]
Thujis 2022	510	1466	956	1466	14.4	0.28 [0.24, 0.33]
Total (95% CI)		5688		5688	100	0.02 [0.00, 0.23]
Total events	793		4895			

Heterogeneity, tau^2=8.78, Chi^2= 1486.42, df=6 (p<0.00001), I^2=100%, test for overall effect z=3.29 (p=0.001)

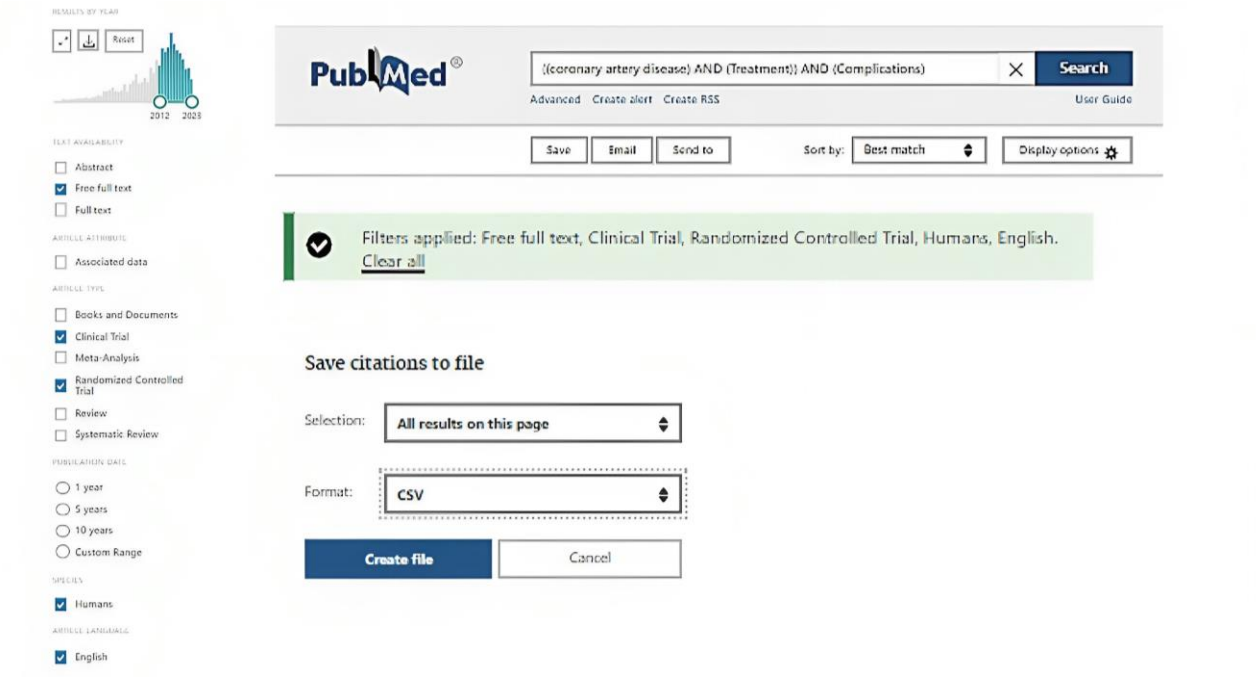

Figure 1: Electronic database search with filters.

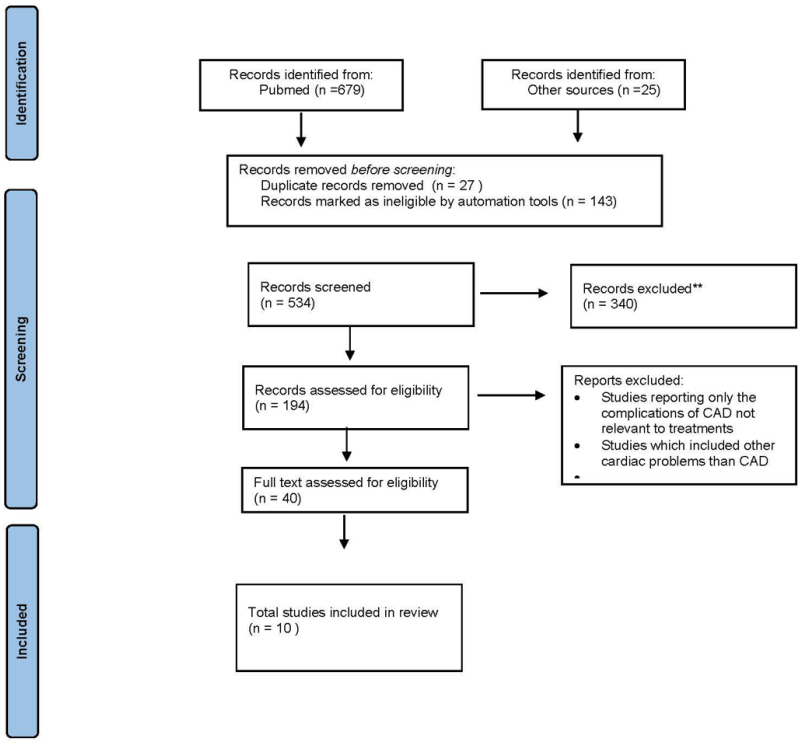

Figure 2: Flow diagram summarizing the literature search process and study selection.

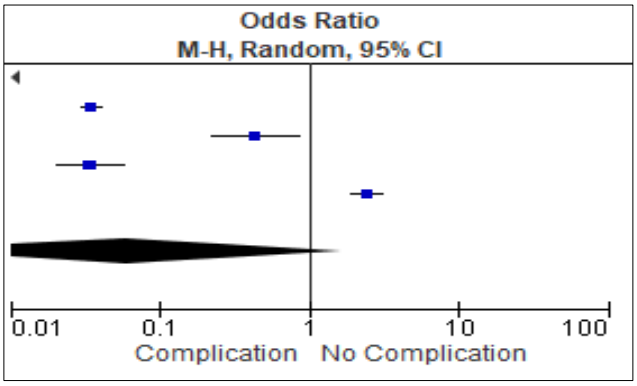

Figure 3: Forest plot of complications associated with conservational treatments.

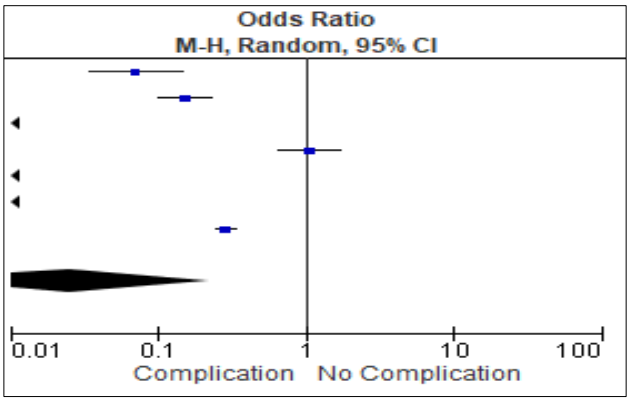

Figure 4: Forest plot of complications associated with surgical treatments.

DISCUSSION

The current meta-analysis investigated ten randomised control trials to analyse the complications CAD patients face because of the type of treatment. In the present investigation, two types of treatments were taken under consideration. One major category was surgical treatment, which included CABG, PCI, Open vein harvesting, and arterial grafts. The other category of treatment was Conservative treatment, including monotherapy or combined therapy of medicines (rivaroxaban, beta-blocker, clopidogrel and ACE-inhibitor). The analysis demonstrated that the complications of CAD were 6% in patients treated with conservative treatment, and 2% faced complications because of surgical treatment. It shows a significant difference between the treatments, and surgical treatment of CAD is better than conservative treatment.

Patients with stable CAD have shown that PCI improves symptoms compared to conservative medical care; however, there is insufficient data on how PCI affects the risk of death, myocardial infarction, and subsequent revascularisation. A similar meta-analysis was conducted to compare PCI and conservative treatments; eleven studies were evaluated. The meta-analysis comprised 2950 patients, of whom 1476 got PCI, and 1474 received traditional care. There was no discernible difference between the two treatment modalities regarding mortality, cardiac death or myocardial infarction, nonfatal myocardial infarction, CABG, or PCI during follow-up.[17]

Aspirin is one of the most commonly used medications in the conservation treatment of CAD. The advantages of aspirin therapy in patients with cardiovascular disease for secondary prevention of ischemic events. It causes an irreversible suppression of Prostaglandin-H synthase (also known as COX) by selectively and quickly acetylating a serine residue in the enzyme's cyclooxygenase (COX) active site. Long-term aspirin therapy prevents platelet aggregation by preventing the development of pro-aggregate prostanoid thromboxane A2, typically generated in platelets by stimulation of COX-1. Even low doses of aspirin help prevent platelet aggregation because they are roughly 170 times more specific for suppressing COX-1 than COX-2. Long-term use of aspirin can result in risk of the upper gastrointestinal system and haemorrhages.[18] In the current review, it has been seen that complications are more prevalent in CAD patients who rely on aspirins or combined medicinal therapies.

The worldwide burden of cardiac health problems is increasing day by day. Improving cardiac issues can only be possible if these issues can be prevented before getting severe. Some advancements have been made in the medical health sector using artificial intelligence and machine learning. With the help of AI, timely diagnosis can be made easily and effectively for cardiac issues. Another approach is genetic analysis; genetic advancement has also helped to find the genes in the family that are at risk and can result in major cardiac problems after a certain age. So, the genetic analysis of families can help to cure the problem before adversity. Further studies should be conducted on cardiac patients' surgical treatments to find the best treatment with the most minor complications.

In the current study, there were only two reviewers to select the studies, and the literature included was only from PubMed; further studies should be done by collecting data from other databases and adding more reviewers. Another limitation of the current study was that the heterogeneity level was 100%, meaning that the studies chosen under the recent analysis differed. Their effect size can be significantly different. Further research can be done where the value of I^2 is less than 100%.

CONCLUSION

In comparison to conservative therapy, the results of this meta-analysis offer strong support for surgical intervention as a better method of treating CAD. The systematic review of the available research and analysis of ten randomised control trials has shown that the surgical procedure is linked to a lower incidence of complications, indicating that it might provide CAD patients with better outcomes and safety. These findings highlight the value of using surgical treatments as the first line of treatment for CAD.

To make well-informed, patient-centred choices regarding the best CAD treatment strategy, healthcare professionals must thoroughly evaluate each patient's clinical characteristics and preferences. More studies and continued outcome monitoring are required to improve treatment protocols and patient care.

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Ethical approval: Not required

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