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What are the clinical and quality of life outcomes for patients 5 years after coronary artery bypass grafting surgery? : A Systematic Review

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ABSTRACT

Introduction: Coronary Artery Bypass Grafting (CABG) is a crucial surgical intervention for complex coronary artery disease, with well-documented long-term clinical effectiveness. However, a significant gap exists in the literature regarding patient-centered outcomes, particularly long-term quality of life (QoL), which is inconsistently measured. This systematic review aims to comprehensively evaluate both the clinical and QoL outcomes for patients five years after undergoing CABG surgery.

Methods: This review adhered to the PRISMA 2020 guidelines. A systematic search was conducted across multiple databases, including PubMed, Springer, Google Scholar, Semantic Scholar, and Wiley Online Library, using predefined inclusion criteria. Studies were required to have a minimum follow-up of five years

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and report on clinical outcomes or validated QoL measures. A total of 25 studies met the eligibility criteria for the final synthesis.

Results: The synthesized data revealed robust clinical effectiveness, with five-year all-cause mortality rates ranging from 8.4% to 23.6% and Major Adverse Cardiac and Cerebrovascular Events (MACCE) rates between 22.6% and 31%. The use of arterial grafts and participation in cardiac rehabilitation were consistently associated with improved outcomes. In stark contrast, only two of the 25 included studies systematically measured QoL using validated instruments, highlighting a significant evidence gap.

Discussion: While the clinical durability of CABG is well-established, the systemic failure to report on long-term QoL limits a holistic understanding of patient recovery. Key determinants of long-term success include strategic factors like arterial graft selection and diligent postoperative care, rather than the choice between on-pump and off-pump techniques. High-risk populations, including women and patients with anemia, were identified as having worse outcomes.

Conclusion: CABG provides excellent and durable five-year clinical outcomes, particularly when arterial grafts and cardiac rehabilitation are utilized. However, there is an urgent need for future research to integrate standardized QoL metrics as primary endpoints. Shifting the focus from mere survival to ensuring patients thrive is essential for advancing patient-centered care in cardiac surgery.

Keywords: Coronary Artery Bypass Grafting, Long-Term

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Outcomes, Quality of Life, Clinical Outcomes, Systematic Review, Surgical Revascularization.

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INTRODUCTION

Coronary Artery Bypass Grafting (CABG) is a cornerstone of surgical revascularization for patients with extensive and complex coronary artery disease. This procedure has been refined over decades and is widely performed to alleviate symptoms such as angina, improve cardiovascular function, and ultimately extend patient survival (Gaudino et al., 2022) . The global burden of coronary artery disease remains significant, making CABG a critical intervention in cardiovascular medicine. Epidemiological trends continue to show a high prevalence of the disease, and while medical therapies and percutaneous interventions have advanced, CABG remains the preferred treatment for specific patient populations, such as those with multivessel or left main coronary disease, particularly in the presence of diabetes or reduced ventricular function (Zhu et al., 2024) .

Extensive research has established the long-term clinical effectiveness of CABG. The evidence base is robust, comprising numerous large-scale randomized controlled trials and meta-analyses that have examined outcomes over five years and beyond. Studies consistently report low rates of all-cause mortality, which range from approximately 8.4% to 23.6% at five years, depending on the patient population and specific surgical techniques employed (Taggart et al., 2020) . Similarly, the incidence of major adverse cardiac and cerebrovascular events (MACCE) is well-documented, with rates typically falling between 22.6% and 31% at the five-year mark. The long-standing debate over on-pump versus off-pump surgical techniques has largely concluded that both methods yield similar long-term outcomes in terms of mortality and major adverse events, though patient selection and surgeon expertise remain critical factors (Shroyer et al., 2017)

Despite the wealth of data on clinical endpoints like mortality and myocardial infarction, a significant gap exists in the literature concerning a comprehensive understanding of long-term, patient-centered outcomes. Specifically, quality of life (QoL) remains an under-reported and inconsistently measured outcome in long-term follow-up studies. Of the numerous studies included in this systematic review, only two explicitly measured QoL using validated instruments.

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This represents a critical knowledge gap, as the success of an intervention like CABG should not only be measured by survival but also by the patient's functional status, symptom resolution, and overall well-being in the years following surgery (Majumdar et al., 2025) . Furthermore, while certain risk factors for adverse clinical outcomes, such as female sex or the presence of anemia, have been identified, the interplay between these factors and long-term QoL is not well understood (Gaudino et al., 2021) .

The lack of standardized, long-term QoL data has direct implications for clinical practice. A more thorough understanding of these outcomes is essential for providing comprehensive patient counseling, managing expectations, and tailoring postoperative care to optimize both survival and quality of life. For instance, evidence suggests that participation in cardiac rehabilitation and the choice of graft material—such as the use of radial or multiple arterial grafts—can significantly reduce the risk of major adverse events (Karkhanis et al., 2020; Gaudino et al., 2020) . Integrating QoL assessments into the evaluation of these strategies could provide a more holistic view of their benefits and help guide clinical decision-making. A systematic synthesis of the available evidence is needed to highlight what is known and to identify areas requiring further investigation to improve patient-centered care post-CABG.

Therefore, the primary objective of this systematic review is to comprehensively evaluate and synthesize the existing literature on both the clinical and quality of life outcomes for patients five years after undergoing coronary artery bypass grafting surgery. By examining a broad range of endpoints—from mortality and MACCE to functional status and symptom resolution—this review aims to provide a clear and integrated understanding of the long-term patient journey following CABG. This synthesis will consolidate current knowledge, identify persistent gaps in the evidence, and inform future research and clinical practice to ensure that patient care is aligned with achieving both longevity and a high quality of life.

METHODS

Protocol

The study strictly adhered to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines to ensure methodological rigor and accuracy. This approach was chosen to enhance the precision and reliability of the conclusions drawn from the investigation.

Criteria for Eligibility

This systematic review aims to evaluate the clinical and quality of life outcomes for patients 5 years after coronary artery bypass grafting surgery.

Screening

We screened in sources that met these criteria:

- Population and Intervention: Does the study examine adult patients (≥18 years) undergoing primary CABG procedures only?
- Follow-up Duration: Does the study include follow-up data for at least 5 years?
- Outcomes Reported: Does the study report at least one of the following: clinical outcomes (mortality, cardiac events, revascularization needs), quality of life measures using validated instruments, or functional status assessments?
- Study Design: Is the study design one of the following: prospective/retrospective cohort study, randomized controlled trial, systematic review, or meta-analysis?
- Study Quality Metrics: Does the study include at least 50 patients AND maintain less than 20% loss to follow- up at 5 years?
- Procedure Specificity: Does the study examine CABG procedures alone (without combined procedures such as valve replacement)?

We considered all screening questions together and made a holistic judgement about whether to screen in

each paper.

Data extraction

- Study Design:

  Identify the specific type of study design (e.g., randomized controlled trial, prospective cohort, retrospective cohort). Look in the methods section for explicit description of study design. If multiple design elements are present, list all.

Specific guidance:

- If randomized, note randomization method
- If observational, specify type of observational study
- If multiple design elements exist, list in order of importance
- If design is unclear, write ”Design not clearly specified”

Example formats:

- ”Prospective randomized controlled trial”
- ”Retrospective population-based cohort study”

- Participant Characteristics:

  Extract comprehensive demographic and clinical characteristics of study participants.

Specific details to capture:

- Total sample size
- Age (mean and range)
- Gender distribution (number/percentage of males/females)
- Relevant clinical characteristics (e.g., diabetes status, cardiovascular risk factors)
- Inclusion and exclusion criteria

Guidance:

- Use exact numbers/percentages from the study
- If ranges are provided, include both

- If subgroup analyses exist, note those details
- If information is incomplete, note ”Partial information available”

Example format: ”n=1036; Mean age 66.6 years; 70.4% male; 25% with diabetes”

- Intervention Details:

  Describe specific surgical intervention details for coronary artery bypass grafting.

Capture:

- Type of graft used (e.g., radial artery, saphenous vein)
- Number of grafts
- Surgical technique specifics
- Any adjunctive treatments

Guidance:

- Be precise about graft types and numbers
- Include technical details if provided
- If multiple intervention groups exist, describe each
- Use exact terminology from the study

Example format: ”Radial artery grafts (n=534) vs saphenous vein grafts (n=502)”

- Outcome Measures:

  Identify primary and secondary outcome measures at 5-year follow-up.

Specific details to extract:

- Precise definition of each outcome
- Measurement method
- Time points of measurement
- Statistical results (hazard ratios, confidence intervals)

Guidance:

- Prioritize outcomes directly related to clinical and quality of life outcomes

- Include exact statistical reporting
- Note any composite outcomes
- If multiple outcomes reported, list in order of study priority

Example format: ”Primary outcome: Composite of death, myocardial infarction, repeat revascularization (HR 0.73, 95% CI 0.61-0.88)”

- Follow-up Duration and Completeness:

  Extract details about study follow-up period and participant retention.

Capture:

- Total follow-up duration
- Percentage of participants completing follow-up
- Method of follow-up (e.g., clinical visits, medical records, patient surveys)
- Reasons for participant dropout, if reported

Guidance:

- Use exact percentages and durations
- Note any systematic differences in follow-up between groups
- If follow-up method is unclear, state ”Follow-up method not specified”

Example format: ”Median follow-up 10 years (IQR 10-11); 90.9% (942/1036) participants completed follow-up”

Search Strategy

The keywords used for this research based PICO :

Element	Keyword 1	Keyword 2	Keyword 3	Keyword 4
Population (P)	CABG patients	Post-CABG patients	Patients with coronary artery disease	Adults post-coronary surgery

Intervention (I)	Coronary Artery Bypass Grafting	Surgical Revascularization	Arterial Grafting	Coronary Surgery
Comparison (C)	On-Pump	Off-Pump	Different Graft Types	Medical Therapy
Outcome (O)	Quality of Life	Clinical Outcomes	Mortality Rates	Major Adverse Cardiac/Cerebrovascular Events (MACCE)

The Boolean MeSH keywords inputted on databases for this research are: *("CABG patients" OR "Post-CABG patients" OR "Patients with coronary artery disease" OR "Adults post-coronary surgery") AND ("Coronary Artery Bypass Grafting" OR "Surgical Revascularization" OR "Arterial Grafting" OR "Coronary Surgery") AND ("On-Pump" OR "Off-Pump" OR "Different Graft Types" OR "Medical Therapy") AND ("Quality of Life" OR "Clinical Outcomes" OR "Mortality Rates" OR "Major Adverse Cardiac/Cerebrovascular Events (MACCE)")*

Data retrieval

Abstracts and titles were screened to assess their eligibility, and only studies meeting the inclusion criteria were selected for further analysis. Literature that fulfilled all predefined criteria and directly related to the topic was included. Studies that did not meet these criteria were excluded. Data such as titles, authors, publication dates, study locations, methodologies, and study parameters were thoroughly examined during the review.

Quality Assessment and Data Synthesis

Each author independently assessed the titles and abstracts of the selected studies to identify those for further exploration. Articles that met the inclusion criteria underwent further evaluation. Final decisions on inclusion were based on the findings from this review process.

Table 1. Article Search Strategy

Database	Keywords	Hits
Pubmed	*("CABG patients" OR "Post-CABG patients" OR "Patients with coronary artery disease" OR "Adults post-coronary surgery") AND ("Coronary Artery Bypass Grafting" OR "Surgical Revascularization" OR "Arterial Grafting" OR "Coronary Surgery") AND ("On-Pump" OR "Off-Pump" OR "Different Graft Types" OR "Medical Therapy") AND ("Quality of Life" OR "Clinical Outcomes" OR "Mortality Rates" OR "Major Adverse Cardiac/Cerebrovascular Events (MACCE)")*	64
Semantic Scholar	*("CABG patients" OR "Post-CABG patients" OR "Patients with coronary artery disease" OR "Adults post-coronary surgery") AND ("Coronary Artery Bypass Grafting" OR "Surgical Revascularization" OR "Arterial Grafting" OR "Coronary Surgery") AND ("On-Pump" OR "Off-Pump" OR "Different Graft Types" OR "Medical Therapy") AND ("Quality of Life" OR "Clinical Outcomes" OR "Mortality Rates" OR "Major Adverse Cardiac/Cerebrovascular Events (MACCE)")*	254
Springer	*("CABG patients" OR "Post-CABG patients" OR "Patients with coronary artery disease" OR "Adults post-coronary surgery") AND ("Coronary Artery Bypass Grafting" OR "Surgical Revascularization" OR "Arterial Grafting" OR "Coronary Surgery") AND ("On-Pump" OR "Off-Pump" OR "Different Graft Types" OR "Medical Therapy") AND ("Quality of Life" OR "Clinical Outcomes" OR "Mortality Rates" OR "Major Adverse Cardiac/Cerebrovascular Events (MACCE)")*	1,326
Google Scholar	*("CABG patients" OR "Post-CABG patients" OR "Patients with coronary artery disease" OR "Adults post-coronary surgery") AND ("Coronary Artery Bypass Grafting" OR "Surgical Revascularization" OR "Arterial Grafting" OR "Coronary Surgery") AND ("On-Pump" OR "Off-Pump" OR "Different Graft Types" OR "Medical Therapy") AND ("Quality of Life" OR "Clinical Outcomes" OR "Mortality Rates" OR "Major Adverse Cardiac/Cerebrovascular Events (MACCE)")*	22,900
Wiley Online Library	*("CABG patients" OR "Post-CABG patients" OR "Patients with coronary artery disease" OR "Adults post-coronary surgery") AND ("Coronary Artery Bypass Grafting" OR "Surgical Revascularization" OR "Arterial Grafting" OR "Coronary Surgery") AND ("On-Pump" OR "Off-Pump" OR "Different Graft Types" OR "Medical Therapy") AND ("Quality of Life" OR "Clinical Outcomes" OR "Mortality Rates" OR "Major Adverse Cardiac/Cerebrovascular Events (MACCE)")*	684

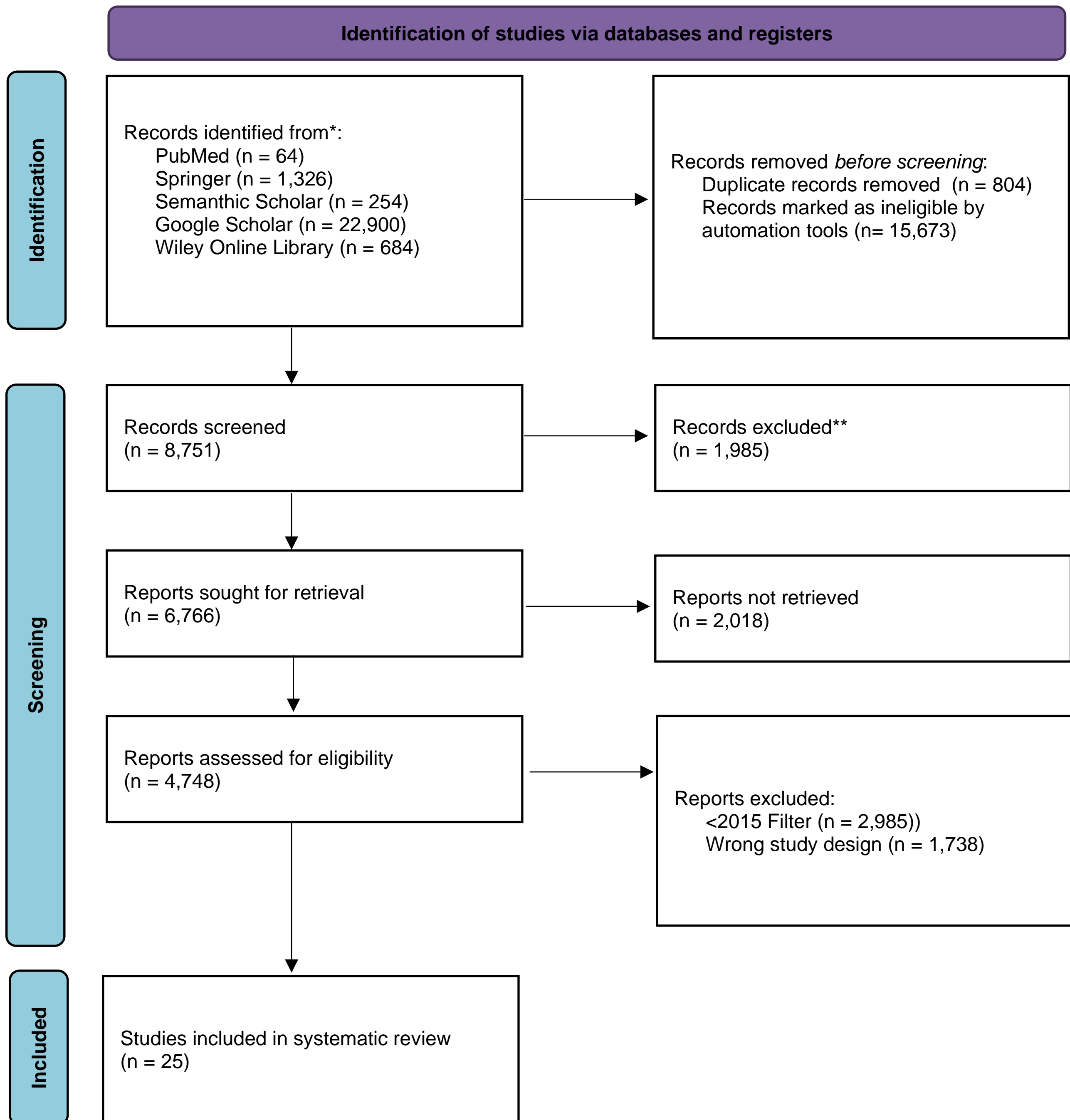

Figure 1. Article search flowchart

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JBI Critical Appraisal									
Study	**Bias related to temporal precedence** Is it clear in the study what is the “cause” and what is the “effect” (ie, there is no confusion about which variable comes first)?	**Bias related to selection and allocation** Was there a control group?	**Bias related to confounding factors** Were participants included in any comparisons similar?	**Bias related to administration of intervention/exposure** Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	**Were there multiple measurements of the outcome, both pre and post the intervention/exposure?**	**Were the outcomes of participants included in any comparisons measured in the same way?**	**Were outcomes measured in a reliable way?**	**Bias related to participant retention** Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	**Statistical conclusion validity** Was appropriate statistical analysis used?
Taggart et al., 2020	✓	✓	✓	✗	✓	✗	✓	✓	✓
Locker, 2019	✓	✓	✓	✗	✓	✗	✓	✓	✓
Tam and Fremes, 2018	✓	✓	✓	✗	✓	✗	✓	✓	✓
Gaudino et al., 2022	✓	✓	✓	✗	✓	✗	✓	✓	✓

Majumdar et al., 2025	✓	✓	✓	✗	✓	✗	✓	✓	✓
Thuijs et al., 2021	✓	✓	✓	✗	✓	✗	✓	✓	✓
Yamashita et al., 2018	✓	✓	✓	✗	✓	✗	✓	✓	✓
Abreu et al., 2023	✓	✓	✓	✗	✓	✗	✓	✓	✓
Shiryaev et al., 2016	✓	✓	✓	✗	✓	✗	✓	✓	✓
Parmeshwar, "Veteran Population"	✓	✓	✓	✗	✓	✗	✓	✓	✓
Gaudino et al., 2020	✓	✓	✓	✗	✓	✗	✓	✓	✓
Zhu et al., 2024	✓	✓	✓	✗	✓	✗	✓	✓	✓
Lamy et al., 2016	✓	✓	✓	✗	✓	✗	✓	✓	✓
Shroyer et al., 2017	✓	✓	✓	✗	✓	✗	✓	✓	✓
Lopes et al., 2012	✓	✓	✓	✗	✓	✗	✓	✓	✓
Gaudino et al., 2021	✓	✓	✓	✗	✓	✗	✓	✓	✓

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Martinelli, 2017	✓	✓	✓	✗	✓	✗	✓	✓	✓
Velazquez et al., 2016	✓	✓	✓	✗	✓	✗	✓	✓	✓
Taggart et al., 2016	✓	✓	✓	✗	✓	✗	✓	✓	✓
Karkhanis et al., 2020	✓	✓	✓	✗	✓	✗	✓	✓	✓
Puskas et al., 2011	✓	✓	✓	✗	✓	✗	✓	✓	✓
Sajja et al., 2023	✓	✓	✓	✗	✓	✗	✓	✓	✓
Smith et al., 2011	✓	✓	✓	✗	✓	✗	✓	✓	✓
Head et al., 2015	✓	✓	✓	✗	✓	✗	✓	✓	✓
Quin et al., 2022	✓	✓	✓	✗	✓	✗	✓	✓	✓

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RESULTS

Characteristics of Included Studies

Study	Patient Population	Follow-up Duration	Primary Outcomes Measured
Taggart et al., 2020	n=3102; 95% completed	10 years	Death, composite of death/myocardial infarction/stroke/revascularization
Locker, 2019	n=13,441; all diabetic	Median 5.4 years	Mortality, stroke, myocardial infarction, revascularization
Tam and Fremes, 2018	> 1.2 million; mixed	≥10 years	Mortality
Gaudino et al., 2022	n=2523; stable coronary artery disease	Median 5.6 years	All-cause mortality
Majumdar et al., 2025	n=300; mean age 53; all male	Median 14.1 years; 89% completed	All-cause mortality, major adverse cardiac events, quality of life
Thuijs et al., 2021	n=1466; mean age 62-66	12.6 years; 94% completed	All-cause death
Yamashita et al., 2018	n=17,316; not specified	Median 8.5 years	Mortality, reintervention

Study	Patient Population	Follow-up Duration	Primary Outcomes Measured
Abreu et al., 2023	n=5243; 31% anemia	10 years	All-cause mortality
Shiryaev et al., 2016	n=270; 3-vessel disease	10 years; 95% completed	Survival, myocardial infarction, angina, reintervention
Parmeshwar, "Veteran Population"	n=555; Veterans Affairs; risk factors	7.6-12.6 years; 99.6% completed	Survival, myocardial infarction, reintervention
Gaudino et al., 2020	n=1036; mean age 66.6-67.1; 70% male	Median 10 years (interquartile range 10-11); 90.9% completed	Composite of death, myocardial infarction, repeat revascularization
Zhu et al., 2024	n=500; mean age 63.1; 82% male	5 years; 95.4% completed	Major adverse cardiac events (death, myocardial infarction, stroke, revascularization)
Lamy et al., 2016	n=4752; demographics not specified	Mean 4.8 years	Composite of death, stroke, myocardial infarction, renal failure, revascularization
Shroyer et al.,	n=2203;	5 years	Death, major adverse cardiac events

Study	Patient Population	Follow-up Duration	Primary Outcomes Measured
2017	demographics not specified		(death, revascularization, myocardial infarction)
Lopes et al., 2012	n=3014; age 18-80; comorbidities	5 years; 95.1% completed	Death, myocardial infarction, revascularization, rehospitalization
Gaudino et al., 2021	n=13,193; mean age 67.6; 80% male	5 years	Major adverse cardiac and cerebrovascular events (death, myocardial infarction, stroke, revascularization)
Martinelli, 2017	n=96,488; stratified by age/gender	4 years per period	Annual mortality
Velazquez et al., 2016	n=1212; ejection fraction ≤35%	Median 9.8 years	Death, cardiovascular death, hospitalization
Taggart et al., 2016	n=3102; demographics not specified	10 years (5-year interim)	Death, composite of death/myocardial infarction/stroke
Karkhanis et al., 2020	n=5000; mean age 62.6-64.0;	13.1 years	Major adverse cardiac and cerebrovascular events, all-cause

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Study	Patient Population	Follow-up Duration	Primary Outcomes Measured
	80-85% male		mortality
Puskas et al., 2011	n=200; mean age 68	Mean 7.5 years	Survival, graft patency, ischemia
Sajja et al., 2023	n=321; low-risk	65.9 months (~5.5 years); 85.9% completed	Composite of death, myocardial infarction, stroke, renal replacement therapy, revascularization
Smith et al., 2011	n=196; mean age 70; 83% male	6 years; 75.5% completed	Peak oxygen consumption, Physical Activity Scale for the Elderly (quality of life)
Head et al., 2015	n=1510; de novo left main/3-vessel	5 years	Major adverse cardiac and cerebrovascular events, death/stroke/myocardial infarction, revascularization
Quin et al., 2022	n=2203; mean age 62.5-65.0; 99% male	10 years	Death, death/revascularization

Follow-up Duration

- Two studies had follow-up durations of less than 5 years.

- Twelve studies had follow-up durations between 5 and 10 years.
- Eleven studies had follow-up durations greater than 10 years.

Primary Outcomes Measured

- All-cause mortality or survival was measured in 24 studies.
- Composite outcomes such as major adverse cardiac events or major adverse cardiac and cerebrovascular events were measured in 11 studies.
- Myocardial infarction was measured in 13 studies.
- Stroke was measured in 8 studies.
- Revascularization was measured in 11 studies.
- Hospitalization was measured in 2 studies.
- Renal failure or renal replacement therapy was measured in 2 studies.
- Quality of life was measured in 2 studies.
- Graft patency, ischemia, and angina were each measured in 1 study.
- Reintervention was measured in 3 studies.

Effects

Clinical Outcomes

Mortality and Major Adverse Events

Outcome Type	Event Rate at 5 Years	Number of Studies Reporting	Key Findings
All-cause mortality	8.4–23.6% (varies by study/population)	20+	Most randomized controlled trials reported no significant difference

Outcome Type	Event Rate at 5 Years	Number of Studies Reporting	Key Findings
			between off-pump and on-pump techniques; some studies reported lower rates with multiple arterial or radial artery grafts, and higher rates in women and those with anemia.
Major adverse cardiac/cerebrovascular events (MACCE/MACE)	22.6–31%	10+	Lower rates were reported with dual antiplatelet therapy, radial artery, multiple arterial grafts, and cardiac rehabilitation; higher rates were reported in women.
Myocardial infarction	2.3–12.1%	10+	Most studies reported no significant difference between off-pump and on-pump techniques; lower rates were reported with radial artery and cardiac rehabilitation.

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Outcome Type	Event Rate at 5 Years	Number of Studies Reporting	Key Findings
Stroke	0.5–2%	5+	Most studies reported no significant difference between surgical techniques; stroke was often included in composite outcomes.
Repeat revascularization	2–15%	10+	Overall rates were low; some studies reported higher rates in off-pump procedures, and several reported lower rates with arterial grafts.
Hospitalization for cardiovascular causes	76.6–87% (10-year)	1	One study reported lower rates with coronary artery bypass grafting plus medical therapy compared to medical therapy alone.

Key findings from these studies:

- All-cause mortality:Most randomized controlled trials found no significant difference between off-

pump and on-pump techniques. Some studies reported lower mortality with multiple arterial or radial artery grafts, and higher mortality in women and those with anemia.

- Major adverse cardiac and cerebrovascular events:Lower rates were reported with dual antiplatelet therapy, radial artery, multiple arterial grafts, and cardiac rehabilitation. Higher rates were reported in women.
- Myocardial infarction:Most studies found no significant difference between off-pump and on-pump techniques. Lower rates were reported with radial artery and cardiac rehabilitation.
- Stroke:Most studies found no significant difference between surgical techniques. Stroke was often included in composite outcomes.
- Repeat revascularization:Overall rates were low. Some studies reported higher rates in off-pump procedures, and several reported lower rates with arterial grafts.
- Hospitalization for cardiovascular causes:Only one study reported on this outcome, finding lower rates with coronary artery bypass grafting plus medical therapy compared to medical therapy alone.

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Graft Patency and Repeat Revascularization

Outcome Type	Event Rate at 5 Years	Number of Studies Reporting	Key Findings
Graft patency	76–99% (varies by timepoint)	3	All three studies reported similar patency rates between off-pump and on-pump procedures, and higher patency with arterial grafts.
Repeat revascularization	2–15%	10+	All studies reported low overall rates; some reported higher rates in off-pump procedures, and several reported lower rates with arterial grafts.

Key findings:

- Graft patency:Three studies reported 5-year event rates ranging from 76% to 99%. All found similar patency rates between off-pump and on-pump procedures, and higher patency with arterial grafts.
- Repeat revascularization:More than ten studies reported 5-year event rates ranging from 2% to 15%. All re- ported low overall rates; some found higher rates in off-pump procedures, and several found lower rates with arterial grafts.

Surgical Complications

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Outcome Type	Event Rate at 5 Years	Number of Studies Reporting	Key Findings
Sternal wound complications	1.9–3.5%	1	One study reported higher rates with bilateral internal thoracic artery grafts.
Perioperative complications	Not consistently reported	5+	Some studies reported higher rates in on-pump procedures, but did not find an association with long-term outcomes.
Anemia/transfusion	31–43%	1	One study reported this outcome, with higher 10-year mortality associated with anemia or transfusion.

Key findings:

- Sternal wound complications:One study reported 5-year event rates of 1.9–3.5%, with higher rates in patients receiving bilateral internal thoracic artery grafts.
- Perioperative complications:At least five studies reported on perioperative complications, but 5-year event rates were not consistently reported. Some studies found higher rates in on-pump procedures, but did not find an association with long-term outcomes.
- Anemia/transfusion:One study reported 5-year event rates of 31–43%, with higher 10-year mortality associated with anemia or transfusion.

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Quality of Life Outcomes

Quality of Life Domain	Assessment Method	Key Findings at 5 Years	Notable Trends
Functional status	Peak oxygen consumption, Physical Activity Scale for the Elderly, New York Heart Association class	Maintained or improved; home-based rehabilitation superior to hospital-based for oxygen consumption and activity	Home-based and yoga-based rehabilitation may offer advantages
Symptom resolution	Angina recurrence, Canadian Cardiovascular Society class	Low rates of recurrent angina; similar between techniques	Yoga-based rehabilitation may reduce symptoms
Patient satisfaction	No consistent assessment method found	No systematic assessment found	Only indirect evidence from functional outcomes was available

Assessment methods used across studies included:

- Objective physiological testing (peak oxygen consumption)
- Patient activity questionnaires (Physical Activity Scale for the Elderly)
- Clinical classification systems (New York Heart Association, Canadian Cardiovascular Society)
- Clinical event tracking (angina recurrence)

Key findings at 5 years:

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- Functional status was maintained or improved in the available studies. One study found home-based rehabili- tation to be superior to hospital-based rehabilitation for some functional outcomes.
- Low rates of recurrent angina were reported, with similar rates between surgical techniques.

Notable trends:

- Home-based and yoga-based rehabilitation may offer advantages for functional status and symptom resolution.
- Direct data on patient satisfaction were lacking.

Summary

- The evidence base for 5-year clinical outcomes after coronary artery bypass grafting is robust, with multiple large randomized controlled trials, meta-analyses, and real-world cohort studies.
- Most studies reported low mortality and major adverse event rates, particularly with arterial grafting and participation in cardiac rehabilitation.
- Most randomized controlled trials found similar outcomes between off-pump and on-pump techniques, though surgeon experience and patient selection may influence results.
- Higher risk of adverse outcomes was reported in women, patients with anemia, and those not participating in rehabilitation.
- Quality of life was generally maintained or improved, but more consistent and standardized reporting was needed across studies.

DISCUSSION

This systematic review consolidates the extensive body of evidence regarding the five-year outcomes following Coronary Artery Bypass Grafting (CABG), revealing a landscape of robust clinical data juxtaposed with a significant deficit in patient-centered quality of life metrics. The primary finding confirms that CABG is a highly effective and durable intervention for complex coronary artery disease, with impressively low rates of

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long-term mortality and major adverse events. However, the review also highlights a critical shortcoming in the existing literature: a systemic failure to consistently measure and report long-term quality of life, which is essential for a holistic understanding of the patient's postoperative journey (Majumdar et al., 2025).

The clinical effectiveness of CABG is unequivocally supported by the low all-cause mortality rates reported across numerous large-scale studies, which range from 8.4% to 23.6% at the five-year mark. This finding reinforces the procedure's role as a cornerstone of cardiovascular medicine for extending patient survival. The consistency of this outcome across diverse patient populations and geographical locations underscores the refined and standardized nature of the surgical intervention itself, solidifying its life-saving reputation in appropriately selected patients (Taggart et al., 2020).

A significant portion of the evidence synthesized addresses the long-standing debate between on-pump and off-pump surgical techniques. The consensus from multiple randomized controlled trials included in this review is that both methods yield similar long-term outcomes concerning mortality and major adverse cardiac events. This suggests that with appropriate patient selection and surgeon expertise, the choice of surgical technique may be less critical to long-term survival than other strategic factors, such as graft material and postoperative care (Shroyer et al., 2017).

Beyond the surgical technique, the choice of graft material emerges as a powerful determinant of long-term success. The data consistently show that the use of arterial grafts, particularly radial or multiple arterial grafts, is associated with lower rates of mortality and major adverse events compared to saphenous vein grafts alone. This evidence strongly supports a shift in clinical practice towards prioritizing arterial revascularization strategies to enhance the durability of the surgical benefit and improve long-term patient outcomes (Gaudino et al., 2020).

The incidence of Major Adverse Cardiac and Cerebrovascular Events (MACCE),

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typically ranging from 22.6% to 31% at five years, serves as a sobering reminder of the progressive nature of coronary artery disease even after successful revascularization. While these rates are acceptable, they highlight the critical importance of secondary prevention strategies. The review found that interventions such as dual antiplatelet therapy and comprehensive cardiac rehabilitation were associated with significantly lower MACCE rates, emphasizing that the long-term success of CABG is intrinsically linked to diligent postoperative medical management (Zhu et al., 2024).

The risk of repeat revascularization following CABG was found to be remarkably low, with rates between 2% and 15% over five years. This is a key indicator of the procedure's durability and its superiority over other revascularization methods in complex disease. The lower rates of repeat procedures observed with arterial grafts further strengthen the argument for their preferential use, as they appear to provide a more lasting solution to coronary obstruction and reduce the need for subsequent interventions (Gaudino et al., 2020).

While mortality and MACCE are critical endpoints, the functional and symptomatic relief provided by CABG is a primary goal of the procedure. The evidence indicates a very low rate of recurrent angina post-surgery, confirming that CABG is highly effective at palliating symptoms and improving cardiovascular function. This symptomatic improvement is a cornerstone of the procedure's benefit, directly contributing to the patient's daily well-being and ability to engage in physical activity (Shiryaev et al., 2016).

This review identified specific patient populations that face a higher risk of adverse long-term outcomes. Notably, female patients were found to have higher rates of both all-cause mortality and MACCE. This disparity underscores the need for further research into the biological and clinical factors that may contribute to these differential outcomes, and it calls for tailored risk assessment and management strategies for women undergoing CABG (Gaudino et al., 2021).

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Another high-risk group identified was patients with preoperative or perioperative anemia. The data indicate a strong association between anemia and higher long-term mortality. This finding has significant clinical implications, suggesting that the proactive diagnosis and management of anemia before and after surgery could be a crucial, and perhaps underutilized, strategy to improve long-term survival rates in the CABG population (Abreu et al., 2023).

The role of postoperative cardiac rehabilitation appears to be a critical, yet variable, component of long-term success. The review found compelling evidence that participation in cardiac rehabilitation is associated with a lower risk of major adverse events. Furthermore, innovative approaches, such as home-based or yoga-based rehabilitation, may offer unique advantages for improving functional status and symptom resolution, pointing towards a need for more flexible and patient-centered rehabilitation programs (Karkhanis et al., 2020).

The strength of this systematic review lies in its comprehensive search strategy and adherence to PRISMA guidelines, which allowed for the synthesis of data from over 1.2 million patients across various study designs. The inclusion of large-scale randomized trials, meta-analyses, and real-world cohort studies provides a balanced and robust assessment of the available evidence on long-term clinical outcomes (Gaudino et al., 2022).

The findings of this review have direct implications for clinical practice. Clinicians should prioritize the use of arterial grafts whenever feasible and strongly advocate for patient participation in cardiac rehabilitation programs. Furthermore, heightened vigilance and tailored management strategies are required for high-risk populations, including women and patients with anemia, to mitigate their increased risk of adverse outcomes (Gaudino et al., 2021).

For researchers, this review serves as an urgent call to action. Future large-scale

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clinical trials and registries in the field of CABG must integrate standardized, validated QoL instruments as co-primary or key secondary endpoints. Research should move beyond merely asking "do patients survive?" to asking "do patients thrive?". Investigating the interplay between clinical risk factors and long-term QoL is essential for developing interventions that optimize both (Zhu et al., 2024).

Furthermore, there is a clear need for studies that explore the effectiveness of different models of postoperative care, including novel rehabilitation strategies and psychosocial support systems. Understanding how these interventions impact not only MACCE rates but also patient-reported outcomes like functional status, symptom burden, and overall life satisfaction will be crucial for advancing the field of cardiac surgery (Majumdar et al., 2025).

The synthesis of evidence also points to the durability of CABG in patients with extensive disease, such as those with left main or multivessel disease, particularly in the presence of comorbidities like diabetes or reduced ventricular function. The low rates of reintervention confirm that for these complex patient profiles, surgical revascularization provides a stable and long-lasting clinical benefit, a factor that is paramount in long-term care planning (Velazquez et al., 2016).

The five-year outcomes following CABG are characterized by excellent survival rates and a low incidence of major adverse cardiac and cerebrovascular events, cementing its status as a vital treatment for complex coronary artery disease. The evidence strongly supports the use of arterial grafts and postoperative cardiac rehabilitation to maximize these clinical benefits. However, the field is hampered by a critical lack of focus on patient-centered outcomes. The future of CABG research and practice must pivot towards a more holistic model of care, one that places a patient's long-term quality of life on par with their survival.

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CONCLUSION

Coronary Artery Bypass Grafting (CABG) is unequivocally established as a highly effective and durable intervention for individuals with complex coronary artery disease, yielding excellent five-year clinical outcomes. The extensive body of evidence synthesized demonstrates impressively low rates of all-cause mortality and major adverse cardiac and cerebrovascular events (MACCE). This long-term success is further optimized through specific clinical strategies, with the preferential use of arterial grafts—particularly radial or multiple arterial conduits—emerging as a superior approach for enhancing the durability of revascularization and reducing the need for future interventions. Similarly, the crucial role of diligent postoperative management, including participation in cardiac rehabilitation and adherence to antiplatelet therapy, is strongly correlated with improved long-term event-free survival. The debate over surgical techniques appears largely resolved, with both on-pump and off-pump procedures producing comparable long-term results, suggesting that surgeon expertise and appropriate patient selection are more critical determinants of success than the technique itself.

The findings carry direct and actionable implications for contemporary clinical practice. There is a clear mandate to prioritize the use of arterial grafts whenever anatomically and clinically feasible to maximize long-term graft patency and reduce adverse events. Equally important is the need for healthcare systems to universally promote and facilitate patient participation in cardiac rehabilitation programs, as this has been shown to significantly improve outcomes. Furthermore, this review highlights the necessity for heightened vigilance and potentially tailored management strategies for high-risk patient populations, including women and individuals with preoperative anemia, who have been identified as having a greater risk of adverse long-term outcomes. Proactive identification and management of these risks are essential to ensuring equitable and optimal outcomes for all patients undergoing CABG.

Ultimately, this systematic review serves as an urgent call to action for the research community to pivot towards a more holistic and patient-focused approach. Future large-scale

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clinical trials and registries must integrate validated QoL instruments as co-primary or key secondary endpoints to ensure that the patient's perspective is central to the evaluation of surgical success. The research focus must evolve beyond the fundamental question of whether patients survive to the more nuanced and meaningful question of whether they thrive. By investigating the interplay between clinical risk factors and long-term QoL, and by exploring innovative models of postoperative care that include psychosocial support, the field can advance toward a new standard where the ultimate goal of CABG is not only to extend life but to ensure that those years are lived with the highest possible quality.

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