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Impact of Internal Mammary Artery Harvesting on Sternal Healing: A Review

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Abstract

Background: Internal mammary artery (IMA) is the preferred conduit for coronary artery bypass grafting (CABG) due to its superior long-term patency. However, its harvesting disrupts sternal vascularization, potentially leading to impaired sternal healing and complications such as sternal wound infection (SWI). This review aims to synthesize current evidence on how IMA harvesting affects sternal healing after CABG, with a focus on surgical techniques, patient risk factors, and postoperative complications. **Objective:** This review aims to provide a comprehensive synthesis of current evidence regarding the impact of IMA harvesting on sternal healing following CABG. **Methods:** A review was conducted using the PubMed and ScienceDirect databases, including studies published from 2015 to 2025. Studies published before 2015 were considered if they provided foundational knowledge and were relevant. Randomized controlled trials (RCTs), propensity studies, and observational studies analyzing IMA harvesting techniques and sternal healing were included. The primary outcomes assessed were SWI, non-union, and delayed healing. **Results:** A total of 13 studies met the inclusion criteria, comprising 6 observational studies, 3 propensity-matched studies, and 4 RCTs. Bilateral IMA grafting was associated with an increased risk of SWI, especially in diabetic and obese patients. However, skeletonized IMA harvesting was linked to improved sternal perfusion and reduced wound complications compared to pedicled techniques. Additionally, interventions such as continuous insulin infusion and low-level laser therapy showed promise in enhancing sternal healing outcomes. **Conclusion:** IMA harvesting impacts sternal healing, particularly in high-risk patients undergoing bilateral IMA grafting. Skeletonized harvesting techniques and optimized perioperative care can mitigate the risk of complications.

Keywords: Coronary Artery Bypass, Healing, Internal Mammary Arteries, Sternum

Review Article

INTRODUCTION

Coronary artery bypass grafting (CABG) remains a cornerstone in the treatment of patients with severe coronary artery disease, particularly those with left anterior descending (LAD) artery occlusion. A critical component of this surgery involves the use of grafts to bypass the blocked coronary vessels, with the internal mammary artery (IMA) being the gold standard for grafting due to its superior long-term patency and histological properties. The IMA is preferred over other grafts, such as the saphenous vein, because of its high resistance to atherosclerosis and better clinical outcomes (M. Li et al., 2024).

While CABG provides significant benefits in improving myocardial perfusion, it necessitates sternotomy, an invasive procedure that disrupts the sternum to provide access to the heart. As a flat bone, the sternum relies on adequate blood supply from the IMA, which is often harvested during CABG. This disruption in sternal perfusion can lead to complications such as sternal wound infection (SWI), non-union, or malunion of the sternum. These complications, particularly after IMA harvesting, remain a significant cause of morbidity and prolonged recovery in CABG patients (Gaudino et al., 2018; Kumar et al., 2024). With the increasing number of CABG procedures performed globally, these complications present an urgent challenge for improving patient outcomes and reducing healthcare costs.

The healing of the sternum following sternotomy is a complex process involving various biological and mechanical factors. Bone regeneration in the sternum typically occurs through intramembranous ossification, a process that is highly dependent on adequate blood supply, oxygenation, and the presence of growth factors. However, when the blood supply is compromised due to IMA harvesting, particularly in bilateral IMA (BIMA), the risk of impaired sternal healing increases significantly (Shin et al., 2015). Furthermore, comorbid conditions such as diabetes mellitus, obesity, and smoking can exacerbate the risk of sternal healing complications, as these conditions are known to impair wound healing and contribute to poor perfusion (Ivert et al., 2024; M. Li et al., 2024).

Previous studies have investigated the effects of different IMA harvesting techniques on sternal wound healing, yet significant gaps remain in understanding how these techniques interact with patient comorbidities. For example, Farghaly et al. (2020) found that skeletonized IMA harvesting reduced the incidence of SWI compared to pedicled harvesting. Similarly, Ravaux et al. (2018) examined the incidence of SWI in high-risk populations undergoing BIMA grafting, finding that although factors such as diabetes and obesity did not significantly increase the risk of SWI, the overall mortality was higher in patients who required reintervention for bleeding. However, these studies primarily focus on individual factors, and comprehensive analyses that explore how different harvesting techniques and comorbid conditions jointly influence sternal healing outcomes are still lacking.

Despite the known risks, research into the specific outcomes of sternal healing after IMA grafting remains limited. While several studies have assessed the impact of different IMA harvesting techniques and grafting approaches (e.g., skeletonized versus pedicled BIMA) on postoperative outcomes, comprehensive analyses of how IMA harvesting affects sternal wound healing, particularly across different patient populations, are still lacking (Parissis & Parissis, 2023). This review aims to fill this gap by synthesizing existing literature on the impact of IMA harvesting on sternal healing, exploring the role of harvesting techniques, comorbidities, and surgical factors that may influence healing.

Given the significant clinical burden of SWI and non-union following CABG, a thorough understanding of sternal healing outcomes is essential. Addressing these challenges is crucial to minimizing postoperative morbidity and improving patient recovery. This review aims to provide a comprehensive synthesis of current evidence regarding the impact of IMA harvesting on sternal healing following CABG. This review focuses on evaluating postoperative complications such as SWI, non-union, and delayed healing in the context of different surgical approaches and patient-related risk factors. Additionally, the findings serve to support clinical decision-making for cardiovascular surgeons by providing relevant insights to enhance patient care, enabling a more informed approach to surgical technique selection and perioperative management.

METHODS

A comprehensive literature search was performed using the PubMed and ScienceDirect databases, focusing on studies published from 2015 to 2025 evaluating the impact of IMA harvesting on sternal healing following CABG. The search strategy incorporated MeSH terms and free-text keywords related to “internal mammary artery,” “sternal healing,” “CABG,” “sternotomy complications,” and “wound infection.”

For PubMed, a structured search was performed using the following query: ("sternal healing" OR "sternotomy healing" OR "sternal wound healing" OR "sternal closure" OR "sternotomy complications" OR "sternal dehiscence" OR "sternal wound infection" OR "mediastinitis" OR "osteomyelitis") AND ("internal mammary artery" OR "internal thoracic artery" OR "IMA graft" OR "internal mammary artery harvesting") AND ("coronary artery bypass" OR "CABG" OR "bypass surgery") AND ("outcome" OR "healing" OR "complications" OR "risk factors" OR "comparison"). For ScienceDirect, the following query was utilized: ("sternal healing" OR sternotomy) AND ("internal mammary artery" OR "internal thoracic artery") AND ("coronary artery bypass" OR CABG) AND (outcome OR complications).

Studies included in this review were randomized controlled trials (RCTs), propensity studies, and observational studies that assessed the impact of IMA harvesting techniques (skeletonized vs. pedicled) on sternal healing. Eligible studies reported postoperative complications such as SWI, non-union, and delayed healing and involved patients undergoing either single (SIMA) or bilateral (BIMA) IMA grafting. While review articles were referenced for contextual discussions, only primary data from RCTs, propensity, and observational studies were included in the analysis. Excluded studies comprised reviews, case reports, and editorials, as well as those with insufficient data on sternal healing outcomes. Additionally, animal studies, *in vitro* research, and non-English articles were not considered.

Two authors independently screened titles and abstracts for relevance, followed by full-text evaluation. Discrepancies were resolved through discussion among the authors. Data extraction focused on study design, population characteristics, IMA harvesting techniques, sternal healing outcomes, and reported complications. Since this study is a review of previously published literature and does not involve human participants, animal subjects, or patient data, ethical approval and informed consent were not required.

It is important to note that this article constitutes a narrative review rather than a systematic review. Although the literature search was conducted in a structured manner, the methodology does not fulfill the formal criteria required for a systematic review. Specifically, the study was not registered in PROSPERO, PRISMA flow diagram was not utilized appropriately, and no formal assessment of study quality or risk of bias was performed using standardized tools such as Cochrane's RoB or the Newcastle-Ottawa Scale. Additionally, only a limited number of studies met the inclusion criteria despite a large initial pool, which further limits the comprehensiveness and generalizability expected in a systematic review. These factors preclude classification as a systematic review. Instead, this review aims to synthesize relevant evidence based on selected high-quality studies to provide a narrative overview of current understanding regarding the impact of internal mammary artery harvesting on sternal healing.

RESULTS

From the literature search, a total of 311 papers were retrieved from PubMed and 3,798 from ScienceDirect. Thirteen studies met the inclusion criteria and were included in this review. These studies consisted of 6 observational studies, 3 studies using propensity score matching, and 4 randomized controlled trials (RCTs). This variation in study design allows for a comprehensive analysis of the impact of IMA harvesting on sternal healing following CABG. The patient populations in these studies covered a wide age range and included various comorbidities such as diabetes, hypertension, chronic obstructive pulmonary disease (COPD), peripheral artery disease (PAD), chronic kidney disease (CKD), and other comorbidities. The studies examined the comparison between SIMA versus BIMA, as well as different IMA harvesting techniques, including skeletonized versus pedicled methods, with or without pleurotomy. The analysis of these surgical approaches provides insight into how graft harvesting techniques and patient characteristics influence sternal healing outcomes and postoperative complications. Findings from studies over the past decade are presented in Table 1.

Table 1. Findings from studies over the past decade

No.	Author	Study Design	Patient Age	Arterial Side	Harvesting Technique	Comorbidities	Key Findings
1.	Saha et al. (2015)	Observational study	Not specified	BIMA	Skeletonized harvesting	Diabetes, hypertension, COPD	Off-pump CABG with BIMA grafting resulted in a low incidence of sternal wound infections, with superficial infections healing with dressing.
2.	Shin et al. (2015)	Observational study	64.4 years	BIMA	Skeletonized	Diabetes, smoking history, cardiovascular disease, CKD, COPD, CHF	Poor early sternal healing was associated with older age, diabetes, and renal dysfunction, but long-term healing was achieved in most patients within 24-48 months.
3.	Ogawa et al. (2016)	Propensity study	65.7-67.2 years	BIMA	Skeletonized	Diabetes, smoking history, dyslipidemia, hypertension, cerebrovascular disease, COPD, peripheral vascular disease, CHF, CKD	Continuous insulin infusion significantly reduced deep sternal wound infections compared to sliding scale insulin therapy in diabetic patients undergoing CABG with BIMA.
4.	Benedetto et al. (2016)	Randomized controlled trial	63-64 years	SIMA vs. BIMA	Pedicled vs. Skeletonized	Diabetes, CHF, smoking history, COPD, PVD, MI	Skeletonized BIMA grafting had similar sternal wound complication rates as pedicled SIMA, suggesting it may be a safer option for high-risk patients.
5.	Ruka et al. (2016)	Observational study	62.9 ± 9.3 years	SIMA vs. BIMA	Not specified	Obesity, Diabetes, Hypertension, COPD	Compared to SIMA, BIMA increases risk of DSWI in obese patients, particularly in those with diabetes, without significant long-term survival benefit.
6.	Iqbal et al. (2016)	Observational study	56.4-57.5 years	IMA	With vs. without pleurotomy	Diabetes, hypertension, COPD, renal failure, smoking history	Harvesting IMA without pleurotomy resulted in significantly fewer respiratory complications and shorter hospital stays compared to pleurotomy.
7.	Itoh et al. (2016)	Observational study	≥75 years	SIMA vs. BIMA	Skeletonized harvesting	Hypertension, Diabetes, PAD, CKD	BIMA associated with improved 10-year survival in elderly patients but increased risk of DSWI compared to SIMA.

8.	Gray et al. (2017)	Randomized controlled trial	63.5-63.7 years	SIMA vs. BIMA	Not specified	Diabetes, hypertension, prior MI, and CHF	BIMA was associated with a slight increase in sternal wound complications and higher healthcare costs within 12 months post-surgery than SIMA.
9.	Lima et al. (2017)	Randomized controlled trial	18-75 years	IMA	Not specified	Hyperglycemia, Diabetes	Low-level laser therapy (LLLT) and light-emitting diode (LED) therapy improved sternotomy healing and reduced wound dehiscence in hyperglycemic and normoglycemic patients.
10.	Nakahara et al. (2018)	Propensity study	66.1-67.8 years	SIMA vs. BIMA	Skeletonized	Diabetes, PAD, Renal Failure	BIMA grafting in hemodialysis patients showed no significant survival benefit over SIMA, but no increase in mortality or perioperative complications.
11.	Zhu et al. (2019)	Propensity study	63.5-66.8 years	SIMA vs. BIMA	Skeletonized and pedicled	Multiple comorbidities including diabetes, obesity, hypertension, dyslipidemia, smoking history, vascular disease, and respiratory disease	BIMA did not significantly increase DSWI compared to SIMA but showed a trend toward higher superficial wound infections.
12.	Guo et al. (2019)	Observational study	60-75 years	BIMA	Skeletonized and pedicled	Hypertension, Diabetes, Peripheral Artery Stenosis	BIMA grafting in elderly patients (60-75 years) showed no significant increase in sternal wound complications compared to younger patients and achieved satisfactory short-term (3-month) results.
13.	Thuijs et al. (2019)	Randomized controlled trial	66.1 ± 9.5 years	SIMA vs. BIMA	Not specified	Diabetes, hypertension, peripheral vascular disease, cerebrovascular disease, smoking history, dyslipidemia, CAD, CHF, MI, aortic abnormality, COPD	There was no significant difference in 3-year mortality, stroke, or MI between the SIMA and BIMA groups, though rehospitalization was higher in the SIMA group.

SIMA: Single internal mammary artery, BIMA: Bilateral internal mammary artery, MI: Myocardial infarction, CAD: Coronary artery disease, COPD: Chronic obstructive pulmonary disease, CHF: Congestive heart failure, CKD: Chronic kidney disease, PVD: Peripheral vascular disease, DSWI: Deep sternal wound infection.

DISCUSSION

Anatomy and Sternal Vascularization

The IMA, also known as the internal thoracic artery, originates from the subclavian artery and supplies blood to the breast and the anterior chest wall. After branching from the subclavian artery, the IMA travels downward along the inner surface of the anterior rib cage, giving off small branches approximately one to two centimeters at the lateral side of the sternum (Shahoud et al., 2025).

The IMA is accompanied by the internal thoracic vein, which drains the same tissues that the IMA vascularizes. Sternal microcirculation is highly dependent on the IMA as the main blood supply; this anatomical factor is the basis for postoperative complications regarding sternal healing impairment among patients who have had the IMA harvested during CABG. The use of the IMA is considered the gold-standard conduit in CABG surgery (Ahmed & Yandrapalli, 2025; Yim et al., 2020).

Collateral Circulation of Sternum

The IMA is a vital conduit in CABG, but its harvesting can impact sternal perfusion. Anatomical studies have identified four primary patterns of perforator branches arising from the IMA: intercostal, sternal, mediastinal, and pectoralis major muscle. These variations influence the degree of sternal vascularization and the potential for ischemic complications following IMA harvesting (Shahoud et al., 2025).

Disruption of sternal perfusion due to IMA harvesting can lead to complications such as osteonecrosis and impaired wound healing. However, the presence of collateral circulation can mitigate these effects by maintaining adequate blood flow to the sternum. Studies have shown that preserving sternal branches during IMA harvesting, particularly through skeletonized techniques, helps maintain sternal perfusion and reduces the risk of SWI (Mamchur et al., 2020; Parissis & Parissis, 2023).

Understanding the anatomical patterns of IMA perforator branches and the role of collateral circulation is crucial for surgical planning. Preserving sternal blood flow during IMA harvesting, especially through skeletonized techniques, can significantly reduce the risk of sternal complications in CABG patients.

Internal Mammary Artery for CABG

Atherosclerosis, characterized by progressive luminal narrowing of coronary arteries, remains a leading cause of myocardial ischemia and infarction. CABG addresses this condition by bypassing occluded segments, restoring perfusion to ischemic myocardium and reducing cardiovascular morbidity (Ahmed & Yandrapalli, 2025; Tomura et al., 2023). While multiple conduits—including the radial artery, gastroepiploic artery, and saphenous vein—are utilized in CABG, the internal mammary artery (IMA) has emerged as the gold standard for bypassing the left anterior descending (LAD) artery, the most frequently occluded vessel in myocardial infarction (Gaba et al., 2024; Tomura et al., 2023).

The use of the IMA grafts have been associated with long-term patency and improved survival as compared to saphenous vein grafts (Royse et al., 2020). However, concerns have been raised regarding sternal wound complications, particularly when BIMA are utilized. Recent studies have indicated that BIMA grafting is associated with an increased risk of SWI compared to SIMA grafting (Gatti et al., 2016). This risk is notably higher in populations such as diabetic and elderly patients (Parissis & Parissis, 2023). A meta-analysis reported that BIMA grafting significantly elevates the risk of both superficial and deep sternal wound complications in these groups (M. Li et al., 2024).

To mitigate the heightened risk of SWIs associated with BIMA grafting, the skeletonization technique has been employed. This method involves dissecting the IMA with minimal surrounding tissue, aiming to preserve sternal blood supply and reduce the incidence of wound complications. Evidence suggests that skeletonized IMA harvesting may decrease the risk of deep SWI (DSWI), particularly in diabetic patients. However, some studies have reported that skeletonization may be associated with higher rates of adverse cardiovascular events at long-term follow-up compared to pedicled harvesting (Gaudino et al., 2021).

Sternal healing following CABG with BIMA grafting is a critical aspect of postoperative recovery. Research indicates that complete sternal healing may take several months postoperatively, with factors such as advanced age, diabetes mellitus, and postoperative complications contributing to delayed healing (Gatti et al., 2016; Parissis & Parissis, 2023). A study assessing sternal healing post-CABG found that a significant proportion of patients exhibited poor sternal healing months after surgery. Therefore, careful patient selection and consideration of these risk factors are essential when planning BIMA grafting to optimize sternal healing outcomes (Shin et al., 2015).

Methods of IMA Harvesting

The IMAs are located on both sides of the sternum and are the preferred conduits for CABG due to their superior long-term patency rates. The method of IMA harvesting significantly influences sternal perfusion and wound healing. Two primary considerations in IMA grafting are the laterality of the harvest, either single (SIMA) or bilateral (BIMA), and the harvesting technique employed, which can be pedicled or skeletonized (Iribarne et al., 2017; Mamchur et al., 2020; Rubino et al., 2018).

In pedicled harvesting, the IMA is removed along with surrounding tissues, including veins, fascia, and lymphatics. While this method ensures a robust blood supply to the graft, it may compromise sternal blood flow, increasing the risk of sternal wound complications. Conversely, skeletonized harvesting involves dissecting the IMA free from adjacent tissues, preserving sternal perfusion. Studies have shown that skeletonized IMA harvesting is associated with a reduced incidence of SWI compared to the pedicled technique (Cheng et al., 2015; Parissis & Parissis, 2023).

The choice between SIMA and BIMA grafting also influences sternal healing outcomes. BIMA grafting offers the advantage of complete arterial revascularization but has been linked to a higher risk of SWI, particularly in patients with comorbidities such as diabetes and advanced age (Ivert et al., 2024; M. Li et al., 2024; Parissis & Parissis, 2023). A meta-analysis reported that BIMA grafting is associated with a significantly increased risk of SWI compared to SIMA (M. Li et al., 2024). Therefore, the decision to utilize BIMA should be carefully considered, weighing the benefits of improved graft patency against the potential for impaired sternal healing.

Sternotomy

Several sternotomy techniques have been developed to minimize postoperative complications and enhance sternal healing. The median sternotomy, which involves a vertical incision along the midline of the sternum, remains the gold standard for CABG due to its comprehensive exposure of the mediastinal structures and coronary circulation. However, despite its advantages, this approach disrupts sternal stability and perfusion, particularly when IMAs are harvested, potentially leading to delayed healing, sternal dehiscence, and an increased risk of sternal wound complications (Cheng et al., 2015).

Proper sternal healing post-surgery is critical in preventing complications such as non-union, DSWI, and mediastinitis. One of the key challenges in sternal healing is maintaining stability of the sternal edges, as lateral distraction forces during respiration and physical activity can impair the bone fusion process. Additionally, reduced sternal perfusion due to IMA harvesting—especially in BIMA grafting—exacerbates the risk of poor bone regeneration. To address these challenges, advancements in sternal closure techniques have been developed to enhance stability, minimize mechanical stress, and optimize vascularization (Gudbjartsson et al., 2016).

In response to these concerns, partial sternotomy techniques, such as manubrium-sparing and xiphoid-sparing incisions, have gained widespread adoption in recent years. These less invasive approaches aim to reduce surgical trauma, preserve sternal blood supply, and promote faster postoperative recovery. Studies have demonstrated that partial sternotomies result in better sternal stability, lower infection rates, and improved functional outcomes compared to full median sternotomy, particularly in patients undergoing isolated valve surgery or minimally invasive CABG (D. Li et al., 2024).

Sternal Healing Process

The human skeleton comprises two primary bone types: cortical (compact) bone and trabecular (spongy) bone. The sternum, a flat bone, predominantly consists of cortical bone and undergoes intramembranous ossification during both development and healing processes. In this mechanism, mesenchymal stem cells differentiate directly into osteoblasts, facilitating bone regeneration without a preceding cartilaginous phase. This is distinct from endochondral ossification, where a cartilage template is first formed and later replaced by bone tissue, a process typical in the development of long bones (Clarke, 2008).

The success of sternal healing is highly dependent on minimizing lateral distraction forces on the sternal edges during the postoperative period. Excessive movement and mechanical stress can lead to sternal non-union, malalignment, or persistent pain, especially in patients with osteoporosis or obesity. This risk is further exacerbated by reduced sternal perfusion from IMA harvesting, making surgical technique selection critical for optimizing patient outcomes. A balanced approach—ensuring adequate surgical access while preserving sternal integrity and perfusion—is essential to reduce complications and improve long-term sternal healing (Cheng et al., 2015; Jęczmyk et al., 2024).

Effective sternal healing post-sternotomy necessitates several critical factors, including adequate oxygenation, nutrient supply, and mineral availability, all of which are contingent upon sufficient sternal perfusion. The IMAs play a pivotal role in providing blood flow to the sternum. Harvesting one or both IMAs for CABG, especially in BIMA procedures, can significantly diminish sternal blood supply. This reduction in perfusion has been associated with delayed or impaired sternal healing and an increased risk of complications such as SWI (Parissis & Parissis, 2023; Shin et al., 2015).

Despite these concerns, the utilization of BIMA grafting offers substantial benefits, including improved long-term graft patency and enhanced patient survival rates. Therefore, the decision to employ BIMA should involve a careful assessment of the potential risks and benefits, considering patient-specific factors such as diabetes, obesity, and overall health status. Strategies to mitigate sternal healing complications include meticulous surgical techniques, such as skeletonization of the IMAs to preserve sternal blood flow, and the implementation of advanced sternal closure methods to enhance stability during the postoperative period (Cheng et al., 2015; Jęczmyk et al., 2024).

Recent Studies on Sternal Healing Outcome

Sternal healing following CABG remains a significant concern, particularly in cases involving IMA harvesting. The impact of different surgical techniques, patient risk factors, and emerging therapeutic strategies has been a focus of recent research to optimize post-surgical recovery and reduce complications such as DSWI, non-union, and mediastinitis.

The choice of IMA harvesting technique significantly influences sternal healing. Studies comparing SIMA and BIMA grafting have reported mixed outcomes. Ruka et al. (2016) found that while BIMA offers potential long-term benefits, it is associated with an increased risk of DSWI, especially in obese and diabetic patients. Similarly, Itoh et al. (2016) reported that elderly patients undergoing BIMA grafting had improved 10-year survival rates but faced a higher incidence of SWI. Zhu et al. (2019) further suggested that while BIMA does not significantly increase DSWI risk compared to SIMA, it may lead to a higher incidence of superficial wound infections.

Skeletonized IMA harvesting, where the artery is carefully dissected to preserve surrounding tissue, has been associated with improved sternal blood supply compared to pedicled harvesting. Guo et al. (2019) found that skeletonized BIMA grafting did not significantly increase sternal wound complications in elderly patients, suggesting its feasibility for selected populations. Similarly, a study by Benedetto et al. (2016) indicated that skeletonized BIMA resulted in comparable sternal wound complications to pedicled SIMA, supporting its use in high-risk patients. Iqbal et al. (2016) highlighted that harvesting IMA without pleurotomy significantly reduced respiratory complications and shortened hospital stays, making it a viable approach for improved recovery.

Apart from surgical techniques, patient comorbidities such as diabetes, obesity, smoking, and chronic kidney disease (CKD) play a crucial role in sternal healing. Shin et al. (2015) found that diabetes and renal dysfunction were strongly associated with poor early healing outcomes, though most patients eventually achieved full recovery within two years. Nakahara et al. (2018) observed that hemodialysis-dependent patients undergoing BIMA grafting did not show increased perioperative mortality, though long-term sternal healing remained an area for further investigation. Thuijs et al. (2019) analyzed long-term CABG outcomes and found no significant difference in mortality, stroke, or myocardial infarction rates between SIMA and BIMA groups; however, rehospitalization was higher in the SIMA cohort.

New therapeutic interventions are being explored to enhance sternal healing post-CABG. Lima et al. (2017) demonstrated that low-level laser therapy (LLLT) and light-emitting diode (LED) therapy significantly improved sternotomy healing and reduced wound dehiscence in hyperglycemic and normoglycemic patients. Furthermore, Ogawa et al. (2016) highlighted the benefits of continuous insulin infusion in diabetic patients, showing a significant reduction in DSWI incidence compared to sliding-scale insulin therapy. Saha et al. (2015) noted that off-pump CABG with BIMA grafting resulted in low SWI rates, with most superficial infections resolving with conservative management.

Opinions, A Pros-And-Cons Analysis, and Limitations

Based on the reviewed studies, it is evident that IMA harvesting plays a crucial role in CABG, but its impact on sternal healing remains a significant concern. The choice between SIMA and BIMA grafting, as well as the technique used (skeletonized vs. pedicled), should be carefully considered based on patient risk factors. In our opinion, while BIMA grafting offers superior long-term patency and survival benefits, its association with DSWI cannot be ignored, especially in high-risk populations such as diabetics, obese patients, and those with chronic kidney disease. Therefore, patient selection should be more refined, and skeletonized IMA harvesting should be prioritized whenever BIMA is performed to reduce the risk of complications.

A comparison of the reviewed studies reveals both strengths and weaknesses. RCTs such as those by Benedetto et al. (2016) and Gray et al. (2017) provide high-quality evidence supporting the use of skeletonized BIMA to reduce sternal complications. However, these studies often involve smaller sample sizes and short-term follow-up, limiting their ability to assess long-term outcomes. Observational studies, such as those by Ruka et al., (2016) and Itoh et al. (2016), provide real-world clinical data that reinforce the risks associated with BIMA, particularly in high-risk populations. Yet, these studies are prone to selection bias and confounding variables, making it difficult to isolate the true effect of IMA harvesting on sternal healing. Additionally, some studies, such as Ogawa et al. (2016), highlight the importance of perioperative management (e.g., continuous insulin infusion) in mitigating the risks of DSWI, suggesting that surgical technique alone is not the sole determinant of sternal healing outcomes.

Despite the wealth of existing literature, several limitations remain. One major gap is the lack of long-term follow-up in many studies, making it unclear whether the initial benefits of skeletonized IMA harvesting persist beyond the early postoperative period. Additionally, there is significant variability in study methodologies, including differences in patient selection criteria, surgical techniques, and definitions of sternal healing outcomes. Some studies fail to account for confounding factors such as perioperative infection control strategies and advancements in postoperative wound management, which could influence their findings. Future research should focus on standardized protocols, larger multi-center trials, and long-term follow-up studies to establish definitive guidelines on the safest and most effective approach to IMA harvesting in CABG.

CONCLUSION

The outcomes of sternal healing following CABG are influenced by multiple factors, including surgical technique, patient comorbidities, and postoperative management strategies. BIMA grafting provides superior long-term cardiovascular benefits, yet it is associated with a higher risk of DSWI and impaired sternal healing, particularly in high-risk populations. The use of skeletonized IMA harvesting has been shown to mitigate some of these risks by preserving sternal perfusion. Additionally, optimizing perioperative glucose control, smoking cessation, and weight management plays a crucial role in reducing complications. Emerging therapies, such as LLLT, enhanced sternal stabilization, and minimally invasive surgical approaches, offer promising avenues for improving healing outcomes. Moving forward, a personalized approach that considers individual patient risks, tailored surgical techniques, and innovative postoperative interventions will be essential in optimizing sternal healing and reducing complications following CABG. Further research is warranted to establish evidence-based guidelines that balance the long-term benefits of arterial grafting with improved sternal healing outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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