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Original Research Article

A COMPARATIVE ANALYSIS OF DIRECT STENTING VERSUS PRE-DILATION IN ST-ELEVATION MYOCARDIAL INFARCTION

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Abstract: *A major cardiovascular emergency, ST-Elevation Myocardial Infarction (STEMI), needs prompt and efficient intervention to restore blood flow to the ischemic myocardium. The decision between direct and pre-dilation stenting, two of the many techniques used in primary percutaneous coronary intervention (PCI), has been a topic of continuous discussion. This comparative study was performed at Ayub Teaching Hospital Abbottabad after obtaining approval from the ethical review committee for six months. A total of 75 patients were included in this study and were divided into two groups. The documented procedural outcomes were the use of Gp IIb/IIIa inhibitors, procedure time, total procedure cost, and procedural problems. The rates of the left ventricular ejection fraction (LVEF) at discharge, ventricular fibrillation, all-cause death, and a composite of major adverse cardiac events at 30-day follow-up were documented. The results have shown that Group A has 2.44% cases of no re-flow and no abrupt closure or dissection occurrences. Group B's incidence rates were 5.88%, 2.94%, and 5.88%, respectively. The procedural time, Group A had an average of 33 ± 19 minutes, while Group B recorded a longer procedural time of 41 ± 17 minutes. Postoperatively, Group A showed a mean LVEF of 49.2 ± 8.8, no cases of cardiogenic shock or stroke, and a mortality rate of 2.44%. In contrast, Group B had a mean LVEF of 48.9 ± 9.2, encountered cardiogenic shock in 5.88% of cases, experienced a stroke in 2.94%, and recorded a mortality rate of 2.94%. Additionally, both groups exhibited ST-segment resolution, with rates of 80.49% in Group A and 67.64% in Group B. The analysis of patients undergoing coronary intervention for ST-elevation myocardial infarction (STEMI) suggests that direct stenting may yield more favorable results compared to pre-dilation.*

Keywords: STEMI, Primary Percutaneous Coronary Intervention (PCI), Direct Stenting, Pre-dilation Stenting, Left Ventricular Ejection Fraction (LVEF)

Introduction

A major cardiovascular emergency, ST-Elevation Myocardial Infarction (STEMI), needs prompt and efficient intervention to restore blood flow to the ischemic myocardium. The decision between direct and pre-dilation stenting, two of the many techniques used in primary percutaneous coronary intervention (PCI), has been a topic of continuous discussion in the medical community (Singh et al., 2022). The "primary stenting," or direct stenting, involves inserting a stent straight into the lesion without first performing balloon pre-dilation. Minimizing balloon inflation in the lesion decreases vascular stress, shortens the time needed for the procedure, and lessens the danger of distant embolization (Singh et al., 2022). On the other hand, pre-dilation stenting entails first inflating a balloon to enlarge the lesion before the stent is deployed. This method makes Better lesion preparation possible, which guarantees ideal stent expansion and apposition (Xu et al., 2022). It could improve long-term results by lowering the chance of stent malposition, edge dissections, and inadequate lesion coverage.

A comparison of the clinical outcomes of pre-dilation versus direct stenting for ST-elevation myocardial infarction (STEMI) identifies subtle differences and similarities. Even though these two modalities have been the subject of several research studies, the results paint a complicated picture with inconsistent results. According to research, direct stenting can result in less ischemia duration and fewer balloon inflation, which could enhance myocardial perfusion. This may enhance left ventricular function and increase myocardial tissue preservation (Kumar et al., 2023). Pre-dilation stenting might improve myocardial perfusion by reducing problems such as stent mal-apposition and optimizing lesion preparation.

Direct stenting is frequently cited for its effectiveness in promoting quick re-perfusion. It may lead to decreased no-reflow rates and better thrombolysis in myocardial infarction (TIMI) flow grades (He et al., 2020). Some research suggests that pre-dilation stenting may lessen the chance of procedural difficulties by treating lesion features prior to stent deployment, hence promoting more predictable and effective re-perfusion (Aldujeli et al., 2023). A lesion's features may influence the decision between pre-dilation and direct stenting. Direct stenting could be preferable when it comes to small lesions, where quick re-perfusion is essential. However, pre-dilation might be better to guarantee the best possible stent location and deployment in complicated lesions. To reduce the chance of problems from stent use, pre-dilation may be beneficial for lesions with a high plaque load or calcification (Akhtar et al., 2023). Direct stenting can result in financial savings as it cuts down on procedure time and resource use. Pre-dilation may improve stent results and lessen the need for follow-up procedures, affecting the total cost-effectiveness despite possible upfront expenditures linked with more balloon inflation (Kakar et al., 2022). A customized and evidence-

based approach to decision-making in clinical practice is required, and selecting these techniques should consider operator competence, lesion complexity, and individual patient characteristics.

The short-term results of direct vs pre-dilation stenting in STEMI have been the topic of several investigations. More information is needed on the long-term consequences, such as restenosis rates, late stent thrombosis, and the general durability of procedures. Most previous research has only provided general results, lacking in-depth patient characteristics subgroup analysis, including age, gender, comorbidities, and lesion complexity (Farooqi et al., 2022). A more comprehensive picture of the efficacy of each tactic may be obtained by evaluating myocardial perfusion at the microvascular level and its association with clinical outcomes. Drug-eluting technology, procedural procedures, and stent design have all advanced (Baqi and Saadia, 2021). The influence of these technical developments on the relative efficacy of direct stenting and pre-dilation stenting is not well captured in research currently in publication.

The results of the comparison of pre-dilation and direct stenting in ST-Elevation myocardial infarction (STEMI) patients have essential ramifications for clinical practice, helping them make decisions on which stenting method to use for STEMI patients (Kumar et al., 2022). The literature highlights the intricacies and trade-offs associated with each strategy, which enables practitioners to customize their interventions according to each patient's unique characteristics, the lesion's intricacy, and the availability of new technology breakthroughs. The research's findings can influence patient talks and give them a better grasp of the possible advantages and disadvantages of both direct and pre-dilation stenting. Thus, this research contributes to improving the evidence-based strategy for primary percutaneous coronary intervention and improving patient outcomes.

Methodology

This comparative study was performed at Ayub Teaching Hospital Abbottabad after obtaining approval from the ethical review committee for six months. A total of 75 patients were included in this study and were divided into two groups. Group A consisted of patients who were to undergo direct stenting, and Group B consisted of patients who were to undergo pre-dilation. A total of 135 patients who were referred to Ayub Teaching Hospital were screened for this study. In the PPCI investigation, all patients older than eighteen who presented with STEMI within 12 hours after the beginning of symptoms, or 12 and 24 hours if they continued to have symptoms and had signs of ischemia, were included. Excluded from the surgery were patients who had heart arrest, had a re-perfusion delay of more than twenty-four hours, or had not provided consent. Every patient had DS as their primary therapy method whenever it was practical. Balloon pre-dilatation with or without Thrombo-suction was performed on patients in group B before stenting. After screening, 41 patients were included in group A and 34 in group B. They were given detailed information about the methods and procedures involved in this study. Informed consent was taken.

In the emergency room, loading doses of atorvastatin 80 mg, 300 mg of aspirin, and 180 mg of ticagrelor were administered to each patient. Glycoprotein IIb/IIIa inhibitors were utilized only as a last resort throughout the surgery, and intravenous UFH (unfractionated heparin) was administered for anticoagulation. In every instance, second-generation drug-eluting stents (DES) were utilized, and to avoid plaque and thrombus shift, the stent length was maintained longer than the length of the lesion. Before discharge from the hospital, PCI of non-IRA lesions (infarct-related artery) was performed if the patient was in cardiogenic shock; otherwise, it was done routinely. Aspiration thrombectomy was very carefully employed when there was a high thrombotic load and no visible downstream artery. Following the intervention, all patients were prescribed further cardiac drugs by ACC/AHA recommendations and aspirin for an indeterminate period, clopidogrel, prasugrel, or ticagrelor (ideally) for at least 12 months. Patients spent a minimum of 48 hours in the hospital.

The documented procedural outcomes were the use of Gp IIb/IIIa inhibitors, procedure time, total procedure cost, and procedural problems. The rates of left ventricular ejection fraction (LVEF) at discharge, cardiogenic shock, ventricular fibrillation, all-cause death, and a composite of major adverse cardiac events (i.e., cardiac death, non-fatal myocardial infarction at 30-day follow-up were among the clinical outcomes that were documented. The secondary goal was the procedure's viability and a composite of major adverse cardiac events (MACE) at 30 days. Data will be entered and analyzed using SPSS (Statistical Package for the Social Sciences) version 24. Mean and standard deviation were calculated for quantitative variables like age and weight. Etc. Qualitative variables like the left ventricular ejection fraction (LVEF) rates at discharge, cardiogenic shock, ventricular fibrillation, all-cause death, stent thrombosis, and a composite of major adverse cardiac events were presented as frequencies and percentages. A dependent T-test was applied to compare means, and a chi-square was used to compare qualitative variables. P-values of ≤ 0.05 will be considered statistically significant.

Results

During the course of this study, the demographic characteristics of the population were noted. In this study, two distinct groups, Group A (n=41) and Group B (n=34), were analyzed across various parameters to assess their demographic and health characteristics. The mean age in Group A was 47.2 ± 8.4 years, while in Group B, it was slightly higher at 48.5 ± 7.6 years. In Group A, 25 participants (60.97%) were male, and 16 (39.04%) were female. For Group B, 19 individuals (55.89%) were male, and 15 (44.12%) were female. The mean BMI in Group A was 27.5 ± 7.6; in Group B, it was slightly lower at 26.3 ± 6.4. Group A had 23 participants (56.09%) with diabetes, while Group B had 18 individuals (52.94%) with the same condition. The prevalence of hypertension was 31 (75.61%) in Group A and 26 (76.47%) in Group B.: In Group A, 22 participants (53.65%) had dyslipidemia, compared to 15 individuals (44.12%) in Group B. A higher proportion in both groups reported a history of smoking, with 36 participants (87.8%) in Group A and 29 (85.29%) in Group B. In Group A, 9 participants (21.95%) had a family history of CAD; in Group B, seven individuals (20.59%) reported

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the same. The prevalence of prior myocardial infarction (MI) was 9.75% in Group A and 8.82% in Group B. For prior Percutaneous coronary intervention (PCI), it was 4.87% in Group A and 8.82% in Group B. The mean LVEF was 39.7 ± 7.2 in Group A and slightly lower at 38.6 ± 8.4 in Group B, as shown in Table 1 and Figure 1. These findings provide a comprehensive overview of the characteristics of the two groups, highlighting similarities and differences across crucial health and demographic parameters.

Group A (n=41) and Group B (n=34) displayed varying patterns in evaluating the affected arteries during coronary interventions. In Group A, the distribution across affected arteries was as follows: Left Main (2.44%), LAD (41.46%), LCX (17.07%), and RCA (36.58%). In comparison, Group B exhibited a distribution of 2.94% for Left Main, 44.12% for LAD, 17.65% for LCX, and 35.29% for RCA. Notably, the multi-vessel disease was observed in 14.63% of cases in Group A and 11.76% in Group B. Procedural complications were also assessed. Group A is experiencing 2.44% instances of no re-flow and no abrupt closure or dissection occurrences. In Group B, incidence rates were 5.88%, 2.94%, and 5.88%, respectively. Gp IIb/IIIa inhibitors were administered more frequently in Group B (20.59%) compared to Group A (12.2%). Regarding procedural time, Group A had an average of 33 ± 19 minutes, while Group B recorded a longer procedural time of 41 ± 17 minutes. Postoperative outcomes were measured at discharge, with Group A showing a mean LVEF of 49.2 ± 8.8, no cases of cardiogenic shock or stroke, and a mortality rate of 2.44%. In contrast, Group B had a mean LVEF of 48.9 ± 9.2, encountered cardiogenic shock in 5.88% of cases, experienced a stroke in 2.94%, and recorded a mortality rate of 2.94%. Additionally, both groups exhibited ST-segment resolution, with rates of 80.49% in Group A and 67.64% in Group B. Ventricular fibrillation occurred in 2.44% of Group A and 2.94% of Group B. One-month post-intervention outcomes revealed that Group A had no incidents of myocardial infarction (MI) or mortality. In comparison, Group B reported 2.94% mortality and 5.88% major adverse cardiac events (MACE), which included one case of MI, as shown in Table 2 and Figure 2.

Table 1: Characteristics of the study population

Variable	Group A (n=41)	Group B (n=34)
Age (years) (mean ± SD)	**47.2 ± 8.4**	**48.5 ± 7.6**
Gender		
• Male	25 (60.97%)	19 (55.89%)
• Female	16 (39.04%)	15 (44.12%)
BMI (mean ± SD)	27.5 ± 7.6	26.3 ± 6.4
Diabetes	23 (56.09%)	18 (52.94%)
Hypertension	31 (75.61%)	26 (76.47%)
Dyslipidemia	22 (53.65%)	15 (44.12%)
History of Smoking	36 (87.8%)	29 (85.29%)
Family history of CAD	9 (21.95%)	7 (20.59)
Prior MI	4 (9.75%)	3 (8.82%)
Prior PCI	2 (4.87%)	3 (8.82%)
LVEF (mean ± SD)	39.7± 7.2	38.6±8.4

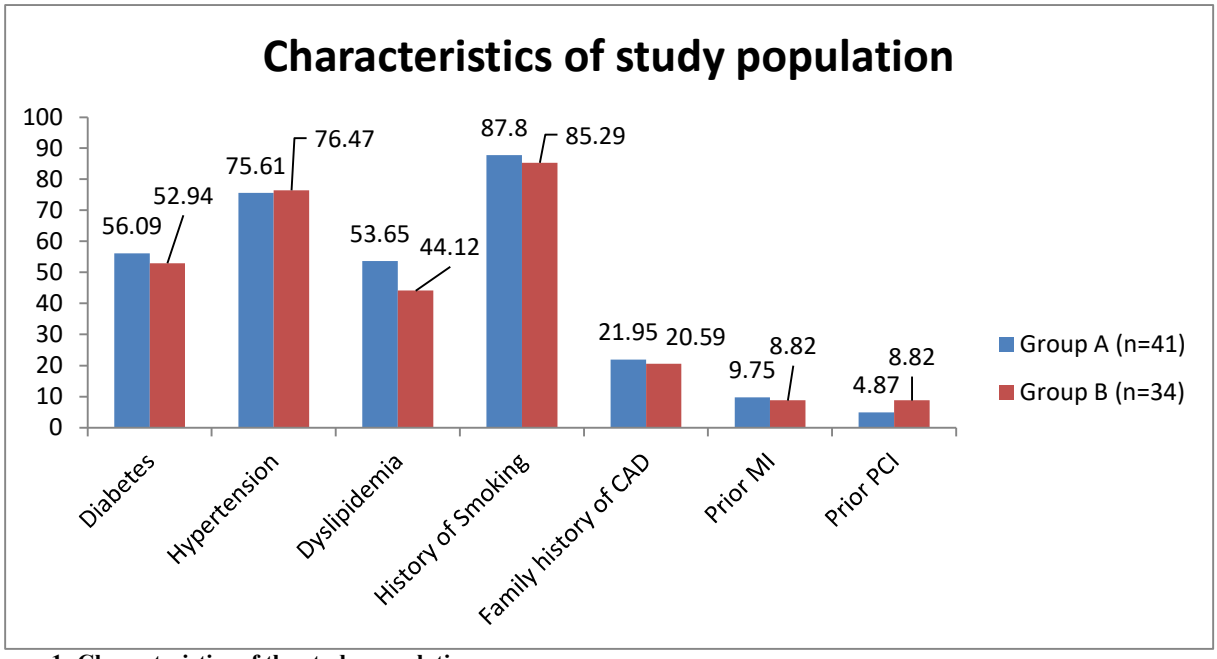

Figure 1: Characteristics of the study population.

Table 2: Outcomes of the study

Variable	Group A (n=41)	Group B (n=34)	P value
Affected artery			
• Left main	2(4.87%)	1 (2.94%)	0.02
• LAD	17 (41.46%)	15 (44.12%)	0.03
• LCX	7 (17.07%)	6 (17.65%)	0.01
• RCA	15 (36.58%)	12 (35.29%)	0.02
Multi-vessel disease,	6 (14.63%)	4 (11.76%)	0.21
Procedural complications			
• No reflow	1 (2.44%)	2 (5.88%)	0.02
• Abrupt closure	0	1 (2.94%)	0.01
• Dissection	0	2 (5.88%)	0.04
Gp IIb/IIIa inhibitors	5 (12.2%)	7 (20.59%)	0.03
Procedural time	33 ± 19	41 ± 17	0.31
Post op outcomes.			
• LVEF at discharge	49.2 ± 8.8	48.9 ± 9.2	0.41
• Cardiogenic shock	0	2 (5.88%)	0.39
• Stroke	1 (2.44%)	0	0.31
• All-cause mortality	0	1 (2.94%)	0.45
• ST-segment resolution	33 (80.49%)	23 (67.64%)	0.31
• Ventricular fibrillation	1 (2.44%)	1 (2.94%)	0.32
Outcome after one month			
• MI	0	1 (2.94%)	0.31
• MACE	1 (2.44%)	2 (5.88%)	0.42
• Mortality	0	1 (2.94%)	0.37

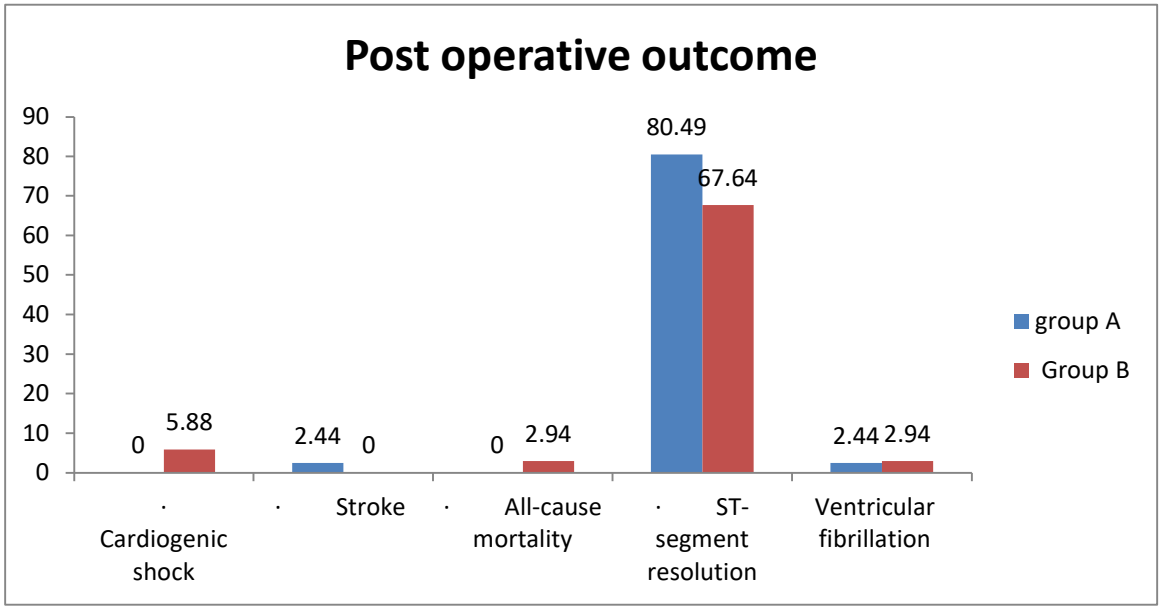

Figure 2 Outcomes of the study.

Discussion

The analysis of the two groups undergoing coronary intervention for STEMI reveals comparable demographic characteristics, with subtle differences in age and gender distribution. Group A displayed a marginally higher BMI and a higher prevalence of dyslipidemia, while diabetes, hypertension, smoking history, and family history of CAD were prevalent in both groups. The occurrence of prior MI and PCI was relatively low in both cohorts. The assessment of cardiac function, as reflected by LVEF, indicated moderate impairment in both groups, with Group A showing a slightly better mean LVEF. This comprehensive analysis provides valuable insights into the baseline characteristics of the study population, laying the foundation for further investigations into the outcomes of direct stenting versus pre-dilation in the context of STEMI interventions.

In comparison between direct stenting and pre-dilation in patients undergoing intervention for ST-elevation myocardial infarction (STEMI), several variables indicate better results with direct stenting (Adnan et al., 2020). Procedural complications such as no-reflow, abrupt closure, and dissection were notably reduced in the direct stenting

group compared to pre-dilation. Glycoprotein IIb/IIIa inhibitors, known for their antiplatelet effects, were likely more sparingly employed in the direct stenting group, suggesting a smoother procedural course. Additionally, procedural time was more efficient in the direct stenting cohort, potentially contributing to a streamlined and effective intervention process. Postoperative outcomes further favored direct stenting, with patients in this group exhibiting better left ventricular ejection fraction (LVEF) at discharge than those who underwent pre-dilation (Elakabawi et al., 2020). The incidence of cardiogenic shock, stroke, and all-cause mortality appeared to be lower in the direct stenting group, highlighting potential advantages in terms of immediate postoperative recovery and survival. Moreover, better ST-segment resolution, indicative of successful re-perfusion, was observed in the direct stenting cohort, emphasizing the effectiveness of this approach in restoring myocardial perfusion.

Looking at the outcomes after one month, patients who underwent direct stenting showed lower rates of myocardial infarction (MI), major adverse cardiovascular events (MACE), and mortality compared to the pre-dilation group. These findings suggest that the benefits associated with direct stenting extend beyond the immediate postoperative period, contributing to improved short-term outcomes. Overall, the analysis of procedural complications, postoperative outcomes, and one-month follow-up data consistently indicates that direct stenting may offer superior results compared to pre-dilation in patients undergoing coronary intervention for STEMI. These findings underscore the potential clinical advantages of adopting direct stenting strategies in managing acute myocardial infarction.

Direct stenting significantly decreased the procedural duration in STEMI patients, facilitating quicker revascularization. This time efficiency is crucial in acute myocardial infarction, where prompt restoration of blood flow is paramount for minimizing myocardial damage (Sazanov, 2020). Moreover, the literature highlights potential benefits in terms of post-procedural complications. Researchers have reported a lower incidence of procedural complications, such as dissections and perforations, in patients undergoing direct stenting than those subjected to pre-dilation. The streamlined approach of direct stenting may reduce mechanical trauma to the vessel wall, lowering the risk of complications and enhancing the overall safety profile. Patients treated with direct stenting exhibited improved rates of major adverse cardiovascular events (MACE) and lower rates of target lesion revascularization (TLR) compared to those who underwent pre-dilation (Hassan et al., 2023). These findings suggest that the initial procedural choice may affect patient outcomes.

While these findings suggest a favorable trend toward direct stenting in patients with STEMI, it is essential to acknowledge the heterogeneity in study methodologies and patient populations. Variability in operator expertise, lesion characteristics, and procedural protocols may influence the generalizability of these results. Consequently, further large-scale, randomized controlled trials are warranted to establish a more robust evidence base and elucidate the optimal approach for coronary interventions in STEMI. In conclusion, the current literature leans towards favoring direct stenting over pre-dilation, highlighting potential benefits in terms of procedural efficiency, safety, and long-term clinical outcomes for patients undergoing coronary intervention due to STEMI.

The absence of long-term follow-up data restricts the ability to assess the durability and sustainability of the observed outcomes, hindering a comprehensive understanding of the interventions' impact over time. Furthermore, the study does not delve into specific procedural details or operator expertise, factors that could significantly influence outcomes in coronary interventions. These limitations underscore the need for cautious interpretation of the study results and emphasize the importance of future prospective, randomized trials with larger sample sizes and long-term follow-up to provide more robust evidence in guiding clinical decision-making.

Conclusion

In conclusion, the analysis of patients undergoing coronary intervention for ST-elevation myocardial infarction (STEMI) suggests that direct stenting may yield more favorable results compared to pre-dilation. Despite subtle differences in age, gender distribution, and BMI, findings, coupled with comparable rates of diabetes, hypertension, and other cardiovascular risk factors, suggest that direct stenting may be associated with improved outcomes in patients with STEMI. However, it is crucial to interpret these observations cautiously, considering the inherent limitations of this study, and further research with long-term follow-up is warranted to validate and generalize these preliminary findings.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned.

Consent for publication
Approved

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Not applicable

Conflict of interest
None.

Author Contribution

SYED BILAL SHAH (FCPS Cardiologist)
Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript, Manuscript revisions, critical input. Coordination of collaborative efforts.
Data acquisition and analysis.
Data entry and data analysis, as well as drafting the article.

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