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ORIGINAL ARTICLE

Evaluating the Role of Heme in Reducing Discomfort during Radial Artery Verapamil Administration

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ABSTRACT

Background: Radial access is increasingly being adopted for coronary angiography and percutaneous procedures because it is safe and enables faster recovery. Splanchnic vascular resistors are frequently administered to prevent spasm in the radial never receiving artery; however, intra-arterial injection of splanchnic vascular resistors often induces regionally focused discomfort and pain. Despite clinical interventions not adequately relieving pain, this remains an important issue in cardiology centers with high patient volumes. To determine whether inclusion of heme in the verapamil injection can alleviate pain and other complications associated with peripheral and transcutaneous catheterization, as well as mitigate discomfort levels

Methods: This comparative study was carried out between May 2023 to July 2023 at Qazi Hussain Ahmed Medical Complex/ Nowshera Medical College, Nowshera. Seventy-eight patients undergoing a cardiac procedure with radial access vertebral artery were included and divided into two random groups: one receiving verapamil alone and the other receiving verapamil plus heme. A pain evaluation was conducted using a numeric pain rating scale immediately after injection. Other outcomes analyzed were the rate of radial artery spasm, need for rescue analgesia, and local complications. Data analysis was done on SPSS version 26 and a p-value of less than 0.05 was considered significant.

Results: The group receiving heme with verapamil reported significantly lower pain scores (mean 2.1 ± 1.4 vs. 4.6 ± 1.8, $p < 0.001$), fewer instances of moderate-to-severe discomfort (15.4% vs. 46.2%, $p = 0.003$), and less need for rescue analgesia (7.7% vs. 25.6%, $p = 0.034$). Radial artery spasm occurred in only 5.1% of patients in the heme group compared to 23.1% in the control group ($p = 0.022$). No significant differences were observed in rates of hematoma or vasovagal symptoms.

Conclusion: Adding heme to verapamil injections during radial artery access significantly improves patient comfort and reduces procedural complications without increasing adverse effects. This simple adjustment may enhance the overall experience and outcomes of patients undergoing coronary procedures.

Keywords: Heme, Verapamil, Radial artery access, Patient discomfort, Coronary angiography, Radial artery spasm, Intra-arterial injection, Cardiology procedures.

INTRODUCTION

The radial artery is now the most commonly used access site for performing coronary angiography and percutaneous coronary interventions due to decreased chances of bleeding, vascular complications, and sooner mobilization of patients in contrast to using femoral access[1]. Notably, the procedure is not devoid of patient discomfort. One of the most complained adverse effects is the burning or stinging pain associated with the intra-arterial injection of vasodilators like verapamil, which is often employed for the prevention of radial artery spasms[2, 3].

Calcium channel blocker verapamil effectively relaxes smooth muscle and prevents spasm; however, its acidic properties can be irritating to the endothelium and adjacent tissues[4]. This reaction, in addition to being noxious, may increase anxiety in patients undergoing cardiac procedures. Attempts to relieve these problems have included changing the speed of injection, dilution methods, and the application of local anesthetics. Nevertheless, such methods have shown mixed results, and the more dependable and physiologically sound methods are still being sought out[5,6].

As a tissue culture metabolite with a possible physiological role in transporting oxygen, heme's function entails active mechanisms in some studies implying heme modulates vascular systems or possesses anti-inflammatory capabilities as well[7]. Its potential usefulness in reducing local discomfort during intra-arterial medication delivery has not received adequate attention. This is likely due to the buffer effect that heme may possess to quell one's oxidative strain, or by modulation of the endothelium which may decrease the irritation caused by verapamil injection[8].

Given the frequency of radial access procedures in modern cardiology and the emphasis on patient-centered care, even modest improvements in comfort can have meaningful clinical impact. This study was designed to evaluate whether the addition of heme to intra-arterial verapamil injections could reduce pain, lower discomfort levels, and decrease the occurrence of spasm- related complications in patients undergoing coronary procedures.

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METHODOLOGY

This comparative study was conducted from May 2023 to July 2023 at Qazi Hussain Ahmed Medical Complex/ Nowshera Medical College, Nowshera. The main goal was to assess if heme overdyeing verapamil injections used during radial artery access would mitigate patient pain and related complications. Institutional ethical review board approval was granted before data collection commenced.

Utilizing a non-probability consecutive sampling method, a total of 78 adult patients who were scheduled to undergo diagnostic or interventional cardiac procedures through radial artery access were enrolled. Prior to participation, all patients provided informed written consent. Patients were randomly allocated into two equal groups of 39 each. The control group was given a standard intra-arterial injection of verapamil, while the second group received verapamil with heme. Patients included in the study were between the ages of 18 and 75, with a confirmed indication for coronary angiography or percutaneous coronary intervention via radial access. Exclusion criteria included allergy to study drugs, severe hepatic or renal impairment, coagulopathy, local infection at the access site, or refusal to consent.

In both groups, radial artery cannulation was performed under aseptic conditions by trained cardiology residents or consultants using standard technique. The verapamil dose was standardized at 2.5 mg, diluted in 10 mL of normal saline. In the heme group, a defined dose of heme was added to the same volume. All injections were administered slowly over 30 to 60 seconds following sheath placement.

Patient discomfort was assessed using a numeric pain rating scale (0 to 10) immediately following injection. Additional measures included the presence of radial artery spasm, local hematoma,

vasovagal symptoms, and the need for rescue analgesia. Hemodynamic parameters were monitored before and after injection.

The primary outcome was the self-reported pain score. Secondary outcomes included the frequency of radial artery spasm, need for rescue analgesia, and other procedural complications. All data were recorded using a standardized proforma. Statistical analysis was performed using SPSS version 26. Descriptive statistics were calculated for all variables. Continuous variables were reported as mean ± standard deviation, while categorical data were presented as frequencies and percentages. Group comparisons were conducted using independent t-tests for continuous variables and chi-square tests for categorical data. A p- value of less than 0.05 was considered statistically significant.

RESULTS

Both groups in the study those who received heme with verapamil and those who received verapamil alone were similar in terms of age, gender, body mass index, and comorbidities. The average age was slightly higher in the heme group, but this difference was not statistically significant. The gender distribution showed more males in both groups, while rates of diabetes, hypertension, and smoking were also balanced. None of these variables showed significant differences, indicating that randomization was successful and groups were well-matched at baseline.

Most procedures were cardiac in nature, with diagnostic coronary angiography being the most frequent in both groups. Percutaneous coronary intervention (PCI) followed in roughly one-third of the cases. Acute coronary syndrome was the leading indication. Radial access was mostly from the right side, and procedures were predominantly performed by experienced interventional cardiologists. There was no statistically significant difference between groups for any of these parameters, confirming procedural consistency across both arms.

Patients in the heme group reported significantly less pain compared to those who received verapamil alone. The average pain score on a scale of 0–10 was less than half in the heme group. Additionally, fewer patients in this group experienced moderate to severe discomfort. The requirement for rescue analgesia was also markedly lower, indicating that the addition of heme effectively minimized injection-related discomfort and improved patient tolerance.

Table 1: Demographic and Clinical Characteristics of Participants (n = 78)

Variable	Heme Group (n = 39)	Non-Heme Group (n = 39)	P-value
Age (mean ± SD)	56.3 ± 9.4	54.7 ± 10.1	0.412
Gender (Male)	25 (64.1%)	23 (59.0%)	0.647
BMI (kg/m²)	27.2 ± 3.8	26.9 ± 3.6	0.722
Diabetes Mellitus	14 (35.9%)	12 (30.8%)	0.629
Hypertension	17 (43.6%)	19 (48.7%)	0.658
Smoker	11 (28.2%)	13 (33.3%)	0.621

Table 2: Cardiology Procedure Profile (n = 78)

Variable	*Heme Group (n = 39)*	*Non-Heme Group (n = 39)*	*P- value*
Diagnostic Coronary Angiography	*24 (61.5%)*	*23 (59.0%)*	*0.817*
Percutaneous Coronary Intervention	*13 (33.3%)*	*14 (35.9%)*	*0.804*
ACS as Indication	*20 (51.3%)*	*18 (46.2%)*	*0.660*
Right Radial Access	*31 (79.5%)*	*30 (76.9%)*	*0.779*
Performed by Interv. Cardiologist	*28 (71.8%)*	*27 (69.2%)*	*0.802*

The frequency of radial artery spasm a known complication of verapamil injections was significantly lower in patients who received heme. Only two patients in the heme group experienced spasm compared to nine in the control group. Other complications like local hematoma and vasovagal symptoms were rare and showed no meaningful differences. These results suggest that heme not only reduces pain but may also contribute to safer, smoother procedures by minimizing vasospastic reactions.

Table 3: Pain and Discomfort Scores between Groups

Variable	Heme Group (n = 39)	Non-Heme Group (n = 39)	P-value
Pain Score (0–10, mean ± SD)	2.1 ± 1.4	4.6 ± 1.8	<0.001
Moderate-to-Severe Discomfort	6 (15.4%)	18 (46.2%)	0.003
Required Rescue Analgesia	3 (7.7%)	10 (25.6%)	0.034

Table 4: Procedure-Related Complications

Complication Type	Heme Group (n = 39)	Non-Heme Group (n = 39)	P- value
Radial Artery Spasm (RAS)	2 (5.1%)	9 (23.1%)	0.022
Local Hematoma	1 (2.6%)	2 (5.1%)	0.554
Vasovagal Symptoms	1 (2.6%)	3 (7.7%)	0.306

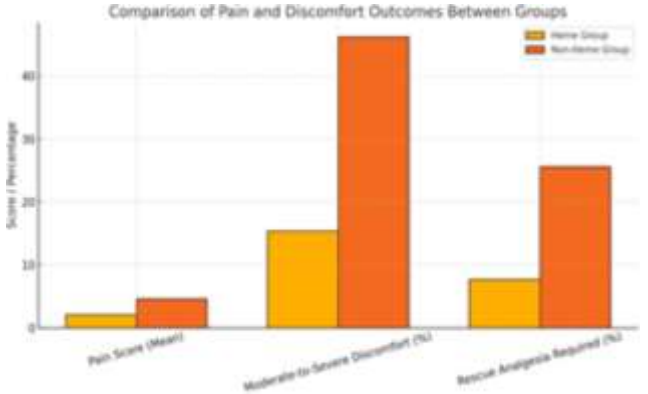

Figure 1: Bar graph comparing pain scores, discomfort levels, and need for rescue analgesia between the heme and non-heme groups. It clearly shows the lower pain and complication rates in the heme group.

DISCUSSION

This study examined whether the addition of heme to intra-arterial verapamil injections during radial access could improve patient comfort and reduce complications. The results showed a clear benefit: patients receiving heme reported significantly lower pain scores, reduced discomfort, and a decreased need for rescue analgesia. These findings suggest that heme may play a protective or modulating role in minimizing injection-related vascular irritation and discomfort.

Radial artery access, although preferred for coronary procedures due to lower bleeding risks and faster recovery, is commonly associated with patient-reported pain during intra-arterial drug administration. Verapamil, a calcium channel blocker, is frequently used to prevent radial artery spasm, yet it often causes transient burning or discomfort when injected. The observed pain relief in the heme group in this study is consistent with the theory that heme may buffer local acidosis or modulate endothelial response, thereby reducing neurovascular irritation[9-11].

Previous research has focused mainly on drug combinations such as lidocaine or fentanyl to reduce injection pain, but few have evaluated the role of biochemical agents like heme. The current findings add to a small but growing body of evidence suggesting that targeted physiological modulation during intra-arterial injections can improve patient outcomes without increasing procedural complexity[12-14].

The significant reduction in radial artery spasm among heme recipients is another important finding. Radial artery spasm not only causes procedural difficulty but is also a source of pain and anxiety for patients. A nearly fourfold reduction in spasm incidence in the heme group points toward its potential benefit in preserving vascular tone during catheter-based interventions[15-17].

The study also found no increase in local complications such as hematoma or vasovagal episodes in the heme group, supporting its safety profile[18-20]. Given the comparable procedural characteristics and operator expertise in both groups, the outcome differences can reasonably be attributed to the intervention itself rather than confounding procedural variables.

However, there are some limitations. This was a single-center study with a modest sample size, which may limit generalizability. Pain perception is subjective and influenced by individual tolerance, anxiety levels, and expectations. Although efforts were made to standardize the pain scale and timing of assessment, a degree of reporting bias is possible. Moreover, the exact pharmacodynamic mechanism of heme in this setting remains speculative and requires further biochemical studies.

Despite these limitations, the findings offer practical value. In high-volume cardiology centers where patient comfort and procedural success are tightly linked, adding heme to verapamil injections may be a simple and effective strategy to enhance care quality. Future multicenter trials with larger populations and mechanistic sub-studies could help validate these results and clarify the exact role of heme in vascular modulation.

CONCLUSION

The addition of heme to radial artery verapamil injections significantly reduced patient discomfort, pain scores, and spasm-related complications during cardiac procedures. This suggests that heme may serve as a beneficial adjunct to standard intra-arterial therapies, improving procedural comfort without compromising safety. Further research is warranted to confirm these findings and explore the broader clinical applications of heme in interventional cardiology.

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