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Preventing and Managing Radial Artery Bleeding following Transradial Procedures: Strategies and Considerations

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ABSTRACT
Background: Cardiac catheterization is an invasive diagnostic procedure using one or more catheters inserted into the heart and certain blood vessels to determine the degree of narrowing in the coronary arteries. Catheterization access through the radial artery shows better results that are not free from complications of bleeding and hematoma.
Purpose: To determine whether there is a relationship between the duration of mechanical compression of the radial artery and the incidence of bleeding.
Methods: Quantitative cross Sectional . The sample size was 40 patients, divided into 2 groups, namely 20 respondents who in aff mechanical compression at three hours and 20 respondents at four hours.
Results: Observations were made every 15 minutes in the first hour, every 30 minutes in the second hour, and every 1 hour in the following hours. Research results: The chi-square test obtained p = 0.038¸ p value ≤ α (0.05) then H0 was rejected, which is statistically interpreted as a relationship, so it can be concluded that there is a significant relationship between the duration of aff mechanical compression on the radial artery and bleeding in post-operative corangiography patient.
Conclusion: There is a significant relationship between the duration of aff mechanical compression of the radial artery and bleeding in post corangiography standby PCI patients. Optimal compression duration is essential to minimize bleeding complications and improve the safety of the procedure.

Keywords: bleeding, mechanical compression, transradial access

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BACKGROUND

Cardiovascular diseases is a disease that affects the heart and blood vessels. Cardiovascular disease classifications include coronary heart disease (CHD) and coronary artery disease (CAD), and acute coronary syndrome (ACS), among other conditions (Sanchis-Gomar et al., 2016). Coronary heart disease is the condition of obstructed blood flow to the coronary arteries of the heart due to plaque or blood vessel fragments (Sipollo & Vinsur, 2023).

Cardiovascular diseases (CVDs) are the leading cause of death globally, taking an estimated 17.9 million lives each year. CVDs are a group of disorders of the heart and blood vessels and include coronary heart disease, cerebrovascular disease, rheumatic heart disease and other conditions. More than four out of five CVD deaths are due to heart attacks and strokes, and one third of these deaths occur prematurely in people under 70 years of age (WHO, 2025) .The prevalence of cardiovascular disease in Indonesia is 1.5% at all ages. This means that in 100 people of all ages, 1.5% have cardiovascular disease. Indonesia has 15 provinces with the highest cardiovascular disease. The age group 65-74 years has the highest risk of CHD with mortality complications, although it does not rule out the possibility that it can occur in the age range (Rahmawati et al., 2020). A total of 186,809 people or around 1.6% consisting of 510,714 men or 1.3% 506,576 woman or 1.6% of the population (Indonesian Ministry of Health, 2021).

Pharmacological therapy and revascularization are appropriate management in coronary heart disease with the acute phase, so as to reduce mortality and morbidity (Ibanez et al., 2018). *Coronary Angiography Standby Percutaneous Coronary Intervention* is the gold standard for diagnosing and determining appropriate treatment for atherosclerotic coronary artery disease. Access to coronary angiography is via the femoral, radial, or ulnar artery (Sadaka et al., 2019). Radial artery for catheterization is one of the safe accesses used by the invasive cardiology community.

Trans Radial Access is said to be safer than trans femoral access for patient with acute coronary syndrome (Aoun et al., 2019). Trans Radial Access (TRA) is widely used in diagnostic coronary angiography and Percutaneous Coronary Intervention (CCI). This is because it can reduce the risk of vascular complications, early ambulation, reduce the duration of hospital stay, and reduce mortality after ST-elevation myocardial infarction (STEMI) *Corangiography Standby PCI* compared to femoral access (Roberts et al., 2019).

This is in line with results of a study that showed that radial access in PCI offers significant advantages over femoral access, including shorter fluoroscopy time, less contrast use, lower bleeding complications, faster ambulation, and shorter hospital stay (Reddy & Kumar, 2025). The final step of coronary angiography fitting is to monitor homeostatis.

Hemostasis is the process of a physiological mechanism or normal mechanism of the body in order to maintain blood circulation. When there is damage to the blood vessels, there will automatically be a process of stopping bleeding spontaneously (Durachim, 2018). In the installation of Angiography, hemostasis is carried out by compression techniques on the radial artery that becomes vascular access either directly of using a comorbid device. Types of hemostasis devices on the radial artery are *HemoBand , RadAr , Stepty -P, TR-Band, and RadiStop* (Nur Fadhilah, 2023).

The results showed the transradial approach for cardiac catheterization, coronary angiography , and percutaneous interventions was associated with a lower risk of access site-related complications compared to the transfemoral approach. (Roy et al., 2022). Other studies have shown no hemostatic differences in either TRA insertion. RAO level at 24 hours evaluated by plethismographic oximetry and confirmed by ultrasonography among 3 current radial hemostatis methods (i.e., patent hemostatis, ULTRA method, and facilitated hemostatis

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with ahemostatic disc) did not differ (Eid-Lidt et al., 2022).

This illustrates that TRA insertion can be used with attention to the complications that can occur. The phenomenon that occurs in the field, one of which is at Dr. Hasan Sadikin General Hospital in Bandung, which is a referral hospital in West Java Province and satellite hospital in cardiovascular disease services at the national level. From the data of cardiac catherization room services at Dr. Hasan Sadikin General Hospital, the number of patients who the heart through radial artery access with the help of mechanical compression devices performed coronary angiography and PCI in 2019 was 794 patients, with an average of 60-70% transradial access.

The hemostatis procedure after corangiography standby PCI at Dr. Hasan Sadikin Bandung Hospital which is carried out by mechanical compression of the radial artery still uses 3 hours and operational procedural standards do not exist. From the results of a study in the CICU room, HCCU Dr. Hasan Sadikin Bandung Hospital im September 2020 from a total of 10 patients after corangiography standby PCI transradial access, 6 patients experienced delays during mechanical compression Aff or more than 3 hour, because spontaneous bleeding still occurred.

This is what underlies this study, namely to determine" The Relationship between the Length of Time of Aff Mechanical Compression of the Radial Artery with the Incidence of Bleeding in Patiens Post *Corangiography Standby PCI Transradial Access* in the CICU, HCCU and Aglonema Rooms of Dr. Hasan Sadikin Hospital". Hasan Sadikin Bandung the number of patients who performed coronary angiography and PCI in 2019 was 794 patients, with an of 60-70% transradial access.

OBJECTIVE

The aim of the study is to determine whether there is a relationship between the duration of mechanical compression of the radial artery and the incidence of bleeding at Dr.Hasan Sadikin Bndung Hospital.

METHODS

The method used in this study is a quantitative method with a descriptive cross sectional approach with incidental sampling technique in accordance with the inclusion criteria of the study obtained 40 people who performed transradial access to Hasan Sadikin Hospital . Data analysis in this study used the chi - square test.

RESULTS

The results showed the frequency of the length of time of mechanical compression of the radial artery, the frequency of bleeding events, and the relationship between the length of mechanical compression of the radial artery with bleeding in post *corangiography standby PCI* patients at Dr. Hasan Sadikin Hospital Bandung.

Frequency Duration of Aff Mechanical compression of Radial Artery

Radial artery mechanical compression AFF time is the length of time taken to achieve hemostatis after catherization of the heart through radial artery access with the help of mechanical comression devices (Ueshima et al., 2018). The following is a table of frequency of the length of time for mechanical compression of the radial artery :

Tabel 1. Frequency Distribution of the Duration of Mechanical Compression of the Radial Artery

Hour	Respondent (n)	Percentage (%)
3 hours	20	50 %

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4 hours	20	50 %
Total	40	100 %

Based on table 1 above, the frequency distribution of the length of time of radial artery compression of respondents in Hasan Sadikin Hospital was 50% at 3 hours and 50% of respondents at 4 hours.

Frequency of Bleeding Events

Hematoma and bleeding in the wound are part of the impact of pancer extarction (aff sheath) for patients who are installed angiography both femoral, brachial and radial artery access installation. The occurrence of bleeding after aff sheath due to lack of pressure or incorrect pressure on aff sheath wound. Pancer wounds that are not treated can result in severe bleeding. The following is a table of the frequency of bleeding events :

Tabel 2. Frequency Distribution of Bleeding Events

Bleeding	Respondent	Percentage (%)
Yes	12	30 %
No	28	70 %
Total	40	100 %

Based on table 2, the frequency distribution of bleeding events after aff sheath from a total 40 respondents was 12 respondents (30 %) and no bleeding occurred as many as 28 respondents (70%).

The relationship between the duration of mechanical compression of the radial artery and bleeding in postoperative patients corangiography standby PCI

The correlation between the duration of mechanical compression of the radial artery and bleeding in post-coronary angiography standby PCI patients is closely related to the importance of compression duration in maintaining stable hemostatis (Nielsen et al., 2025). The following table shows the relationship between the duration of mechanical compression and bleeding :

Tabel 3. Cross-Table Distribution of the Duration of Mechanical Compression of the Radial Artery with the Incidence of Bleeding in Postoperative Patients Craniocerebral angiography Standby PCI

Length of time for mechanical compression of the radial artery	Bleeding Patient			
	Yes	No	Total	*P alue*
3 Hour	9	11	20	
4 Hour	3	17	20	0,038
Total	12	28	40	

Based on table 3 above, the statistical test results obtained a p value = 0.038, the p value ≤ α (0.05) then Ho is rejected, which is statistically interpreted as a relationship, it can be concluded that there is a significant relationship between the length of time of mechanical compression of the radial artery with the incidence of bleeding in post corangiography standby in the CICU, HCCU and Aglonema rooms of Dr. Hasan Sadikin Hospital, Bandung.

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DISCUSSION

Mechanical compression is an action to stop bleeding (Hemostatic) after transradial angiography or Pff Compression is a treatment action that is carried out at a predetermined time according to the hospital's SOP after *the aff sheath* catheter is carried out in in post *corangiography transradial access.* In this study, there was only one type of mechanical compression tool, namely a radial band type tourniquet . Based on the results of the study, the frequency distribution of the length of time for mechanical compression of the radial artery was 3 hours as many 20 respondents and 4 hours as many 20 respondents.

The results of this study are in line with the results of the study which showed that the clamp duration of 20 minutes vs. 60 minutes showed higher RAO in the 20 minute group without presentation of a duration of 3 hours or 4 hours. This show compression of 1-3 hours reduces the risk of bleeding (Lavi et al., 2017). The results of other studies show that the 1-3 hours required during compression can reduce the risk of complications in the radial artery (Nobrega et al., 2018). This in line with results research that shows duration compression mechanics > 4 hours can cause complications such as ROA, so that recommended time is 1-3 hours (Lounes et al., 2025).

In this study, mechanical compression was observed for the first 15 minutes, then 30 minutes after that it was observed every hour. In the compression carried out 3 hours at the 2nd hour the compression device began to loosen 2 turns. Then continue to loosen every 15 minutes 2 turns while observing signs of bleeding in the insertion area, if after loosening there is bleeding occurs after loosening, there is bleeding in the insertion area, if after loosening there is bleeding the compression is tightened again. Perform the first step from the beginning again. For the 4-hour mechanical comptression bleeding occurs, start the initial step again. If there is no bleeding, cover the incision are with gauze and plaster.

Bleeding is the release of blood from the vascular system or blood vessels caused by damage or rupture of blood vessels in the arteries, veins, and capillaries internally and externally (WHO, 2018) . Based on the results of research at Hasan Sadikin Hospital, Bandung, it was found that the incision area after mechanical compression aff was most prevalent in the 3rd hour of mechanical compression aff as many as 9 respondents and as manu as 3 respondents in the 4th hour.

This is in line with the results of research in Brazil which shows that mechanical compression for 4 hours causes minor bleeding as much as 9% (Córdova et al., 2018) . The results of another study showed that the intervention group with mechanical compression for 4 hour with continous deflation gave optimal result, namely good hemostatis with a low risk of complications (Jia et al., 2024). Mechanical compression for 3-4 hours resulted in minor bleeding of 6.1% in 180 patients after PCI and without large hematomas (Megaly et al., 2021).

The incidence of bleeding at 3 hour still occurs due to the duration of action of more than 1 hour because the duration of action is related to the administration of heparin usage, the higher the bleeding. Minor bleeding in the 3rd and 4th hour was due to hypertension and during coronary angiography and hemostatis procedures, these pressure above 150/90mmHg (Roy et al., 2022) . The duration of mechanical compression of the radial artery after sheath removal (aff sheath) affects the risk of bleeding, both minor and hematoma. The Duration of compression is directly related to the stability of hemostatis at the puncture site (Campos et al., 2018) . The results of a study conducted at Hasan Sadikin Hospital, Bandung showed that there was a significant relationship between the length of mechanical compression of the radial artery and bleeding in post *corangiography standby* patients.

In line with this study, some research results show that there is a significant relationship between mechanical compression and bleeding. Too short compression (≤1 hour) increases the

risk of minor bleeding and the highest minor bleeding occurs in 0.5-hour (12%) and 1-hour (19%) groups, compared to the 2 hour group (8%) (Takamatsu et al., 2023) . Other studies have shown that too short a duration of mechanical compression increases the risk of failed hemostatis or hematoma and too long a duration > 4 hours causes RAO, so the relationship between compression time and bleeding is highly correlated (Maqsood et al., 2023).

CONCLUSION

There is a relationship between the lengthof time of mechanical compression of the radial artery and the incidence of bleeding in patient post corangiography standby PCI transradial access at Dr. Hasan Sadikin Hospital Bandung. This is shown by the results of study which showed the length of time from mechanical compression of the radial artery until no bleeding occurred at the 4th hour compared to the 3rd hour so that the incidence of minor bleeding occurred at 4 hours after mechanical compression.

The physiological mechanism of hemostasis after Coronary Angiography with Standby Percutaneous Coronary Intervention (PCI) involves a balance between vasoconstriction, platelet aggregation, and activation of the coagulation cascade to form a stable blood clot at the arterial puncture site. However, prolonged duration of mechanical compression may disrupt this balance by decreasing local tissue perfusion, slowing the endothelial recovery process, and increasing the risk of bleeding and hematoma formation. Clinically, these findings confirm the importance of optimizing, rather than prolonging, the duration of compression to achieve effective hemostasis without causing additional vascular injury. Standardized, evidence-based compression protocols that take into account patient factors and procedural variables are needed to improve hemostatic safety and overall clinical outcomes.

Suggestions for hospital institutions are to consider the results of this study as a basic for reference in modifying and establishing standard operating procedures (SOP) related to hemostasis using mechanical compression which was previously for 3 hours to 4 hours in post corangiography standby PCI patients with certain criteria such as seen from the dose of anticoagulant during action or patients with a history of hypertension.

Suggestions for further researchers are that this study can be a reference and guideline for further research on the duration of mechanical compression of the radial artery in post corangiography Standby PCI patients. This study can also be a reference for conducting further research on factors that cause the duration of mechanical compression in post post corangiography standby PCI patients.

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