An-Najah National University

Faculty of Graduate Studies

COMPARING THE USE OF IDOCAINE WITH NITROGLYCERIN VERSUS LIDOCAINE FOR PATIENTS UNDERGOING CARDIAC CATHETERIZATION FROM A RADIAL ROUTE IN TERMS OF PAIN INTENSITY, PATIENT SATISFACTION, AND SIDE EFFECTS

By

Mohammad Arafat Mohammad Qadous

Supervisors

Dr. Eman Shawish

Dr. Yunis Ammoruri

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This thesis was Defended successfully on 10/04/2024, and approved by:

Dr. Eman Shawish Supervisor	Dr. Eman Alshawish Signature
Dr. Yunis Ammoruri Co-Supervisor	Dr Yunis Ammoruri Signature
Dr. Maha Nahal External Examiner	Dr. Maha N Signature
Dr. Aidah Al-Kaissi Internal Examiner	Aidah Alkaissi Signature

Dedication

الحمد لله رب العالمين حمدا كثيرا حتى يبلغ الحمد منتهاه والصلاه والسلام على اشرف المرسلين سيد الخلق قائد الحق ومعلمي وقدوتي محمد صلى الله عليه وسلم وعلى اله وصحبه اجمعين وبعد قال تعالى في كتابه الكريم

﴿وَمَن يَشْكُرْ فَإِنَّمَا يَشْكُرُ لِنَفْسِهِۦ﴾[لقمان:12]

في البدايه اني اشكر الله عز وجل وافر الشكر على توفيقه لي ان أعانني على اتمام رسالتي العلمية ووفقني في الوصول الى هذه المرحله العلمية العالية .

وانني أتوجه بالشكر والامتنان لوالدي العزيز ووالدتي الكريمة وزوجتي الحبيبة الذين كانوا السند الاول لي في الوصول الى ما وصلت اليه فجزاهم الله عني خير الجزاء

الرحمة على شهدائنا الابرار الاكرم منا جميعا والحرية القريبة لأسرانا ومسرانا باذن الله تعالى

Acknowledgement

أتوجه بالشكر والامتنان لأساتذتي د. ايمان الشاويش د. يونس دار عموري حفظهم الله فقد كان لإشرافهم ومنحهم الكثير من الوقت لي اليد الاولى في اتمام هذه الرسالة العلمية بالشكل الذي ظهرت عليه من توجيه ونصائح منهم فجزاهم الله كل خير.

والشكر موصول لاعضاء لجنه المناقشة الكرام من د. عائدة القيسي د. مها نحال على تفضلهم بقبول مناقشة رسالة الماجستير هذه بالاضافة الى شكري الكبير لجميع افراد عينة الدراسه الذين منحوني الكثير من وقتهم وبذلوا الكثير من الجهود في سبيل خروج الرسالة بأدق النتائج واكثر فعالية.

وفي الختام اســـال الله العظيم رب العرش العظيم ان ينفعنا بهذا العلم وان ينفع به امة الإســـلام عامة وبلدي فلسطين خاصة واهدي هذا العمل لوطني الحبيب فلسطين فسلاح العلم هو اعتى سلاح يهابه كل الاعداء.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

COMPARING THE USE OF IDOCAINE WITH NITROGLYCERIN VERSUS LIDOCAINE FOR PATIENTS UNDERGOING CARDIAC CATHETERIZATION FROM A RADIAL ROUTE IN TERMS OF PAIN INTENSITY, PATIENT SATISFACTION, AND SIDE EFFECTS

Unless otherwise referenced, I declare that the work provided in this thesis is the researcher's work and has not been submitted elsewhere for any other degree or qualification.

Student's Name: محمد عوفات محمد قادوس

Signature: Mohammad Qadous

Date: 10/04/2024

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Abstract

Cardiac catheterizations are specific and complex procedures that are performed either as therapeutic or diagnostic approaches in ischemic heart disease and coronary artery disease. Despite their undisputable benefits, they can also be associated with procedural and post-procedural complications including bleeding, hematoma, pain, radial artery spasms, and occlusion.

This study was conducted to investigate and compare the effects of adding nitroglycerin to lidocaine compared to lidocaine for patients undergoing cardiac catheterization from a radial route.

This was a single-center prospective randomized double-blind study that was conducted among patients scheduled for trans-radial cardiac catheterization. The interventional cardiologist and the patient were blinded to the type of anesthesia. The patients were assigned to receive either the intervention (Group A) or the standard treatment (Group B, control). The intervention consisted of subcutaneous 40 mg of lidocaine with 200 µg of nitroglycerin and intra-arterial 200 µg of nitroglycerin. The standard treatment (control) consisted of subcutaneous 40 mg of lidocaine and intra-arterial 200 µg of nitroglycerin. The assignment was made randomly.

A total of 100 patients were selected randomly and distributed into two groups: 50 patients were allocated to Group A and 50 patients were allocated to Group B. The study patients in both groups were not different in demographic, clinical, and procedural variables (P-value > 0.05). In this study, the addition of nitroglycerin caused significantly less paleness and coldness as an indication of causing less ischemia to the hand (P-value < 0.05). Additionally, the patients who received nitroglycerin in addition to lidocaine

reported statistically significant higher satisfaction compared to the patients who received lidocaine (P-value < 0.05).

The findings of this study demonstrated that adding nitroglycerin to lidocaine significantly decreased indicators of hand ischemia as indicated by reduced paleness and coldness. Additionally, adding nitroglycerin to lidocaine significantly increased patient satisfaction. There were no statistically significant differences or increases in puncture time and duration of the intervention. The findings reported in this study might be used by interventional cardiologists and other healthcare providers to improve the provision of trans-radial cardiac catheterization care by reducing complications and improving the safety and recovery of patients. Based on the findings of this study, interventional cardiologists are recommended to add nitroglycerin to lidocaine to reduce hand ischemia and improve patient satisfaction.

Keywords: Cardiac intervention; Lidocaine; Nitroglycerin; Pain; Radial artery occlusion; Radial artery spasm; Satisfaction; Trans-radial cardiac catheterization

Chapter One

Introduction and Theoretical Background

This chapter aims to provide an introduction and a theoretical background. The chapter provides the theoretical and operational definitions of the key concepts. Additionally, the chapter provide an introduction and a theoretical background to ischemic heart disease, epidemiology, complications, risk factors, signs and symptoms, and preventive strategies. Moreover, this chapter also outlines the different cardiac catheterization approaches focusing on the trans-radial approach. Issues like pain and occurrence of procedural and postprocedural complications. The chapter also outlines the problem statement, the conceptual framework, the study questions, aims and objectives, and hypotheses.

Worldwide, cardiovascular diseases are the most common cause of mortality. The worldwide burden of cardiovascular diseases remains significant in developing and developed countries. According to recent estimates, cardiovascular diseases caused 17.8 million deaths around the globe (Collaborators, 2018).

Myocardial infarctions occur when arteries that supply the heart with oxygen get blocked and muscles of the heart start to die due to a reduction in oxygen supplies to the heart muscle cells (Thygesen et al., 2018). It is noteworthy to mention that before a life-threatening myocardial infarction, the majority of patients experience no symptoms (Elliott et al., 2019). According to recent estimates, ischemic heart diseases impact the lives of 197.2 million (177.7 – 219.5) million patients around the globe in 2019 (Safiri et al., 2022). In addition, ischemic heart disease caused 9.1 million (8.4 – 9.7) deaths. Similarly, many previous large studies have reported that males are more affected by ischemic heart disease compared to their female counterparts. In addition, hypertension, dyslipidemia, and smoking were shown to be the largest contributors to ischemic heart disease worldwide (Safiri et al., 2022).

Because of the significant burden and considerable mortality and morbidity attributed to ischemic heart disease, identifying the risk factors that contribute to ischemic heart disease is considered of paramount importance. Previous studies have reported that sex, age, familial history of cardiovascular diseases, and ethnicity were non-modifiable risk factors (Malakar et al., 2019; Safiri et al., 2022). Conversely, elevated blood pressure,

dyslipidemia, smoking status, overweight/obesity, sedentary lifestyle, poor dietary habits, and stress are all modifiable risk factors (Malakar et al., 2019).

The coronary artery is made up of a muscular medium around which fibers are arranged in a circular pattern (Milutinović, Šuput, & Zorc-Pleskovič, 2020). The intima is separated from the media by an internal elastic membrane that is made up of connective tissues that are delicately connected with a layer of endothelial cells. The media is separated from the adventitia by an exterior elastic membrane (Milutinović et al., 2020). There is an additional layer that lies to separate the intima from the media. This layer is composed of musculo-elastic tissues that connect to localized smooth muscles through connective tissues.

The coronary arteries often acquire atherosclerosis as a result of chronic, repetitive, multifactorial insult to the arterial wall (Milutinović et al., 2020). The disease is caused by endothelial disruption and is mediated by inflammation. This inflammatory response promotes platelets, lymphocytes, and monocytes to accumulate on and around lesion areas as facilitated by overexpression of adhesion molecules. This can lead to an atherosclerotic plaque which requires low-density lipoprotein to accumulate. Atherosclerotic plaques are intimal thickenings with endothelial linings and contents consisting of foam cells produced by vascular smooth muscle cells, macrophages, fibrous tissues, extracellular lipids, and other substances (Daghem, Bing, Fayad, & Dweck, 2020; van Rosendael et al., 2021). Because of the high incidence of disease among patients in different age groups, early detection is very important. Early signs can be detected through history taking and physical examination. Additionally, more diagnosis procedures including electrocardiograms and cardiac biomarkers can also be conducted (Jensen, Hjortbak, & Bøtker, 2020; Toh et al., 2022). Ischemic heart disease can lead to serious consequences like myocardial infarctions, arrythmias, and heart failure. Therefore, preventive measures by mitigating the modifiable risk factors can be used to prevent these consequences.

In invasive cardiology, cardiac catheterizations are performed by passing catheters into the left side or right of the heart to obtain diagnostic guidance about the heart itself or the blood vessel (Vefalı & Sarıçam, 2020). The administration of lidocaine as a local anesthetic is usually the first step in most endovascular operations conducted via radial artery access. Over the years, it became apparent that it is important to also administer

adjunctive agents along with lidocaine to reduce arterial spasms and other complications that can be associated with cardiac catheterization procedures. These adjunctive agents include nitrates, opioids, benzodiazepines, and calcium channel blockers. These agents were administered via various routes, including oral, subcutaneous, sublingual, intravenous, and intra-arterial routes. These routes of administration were used in an attempt to avoid the uncomfortable consequences for both the patient and the operator (Vefalı & Sarıçam, 2020).

1.1 Definitions of key terms

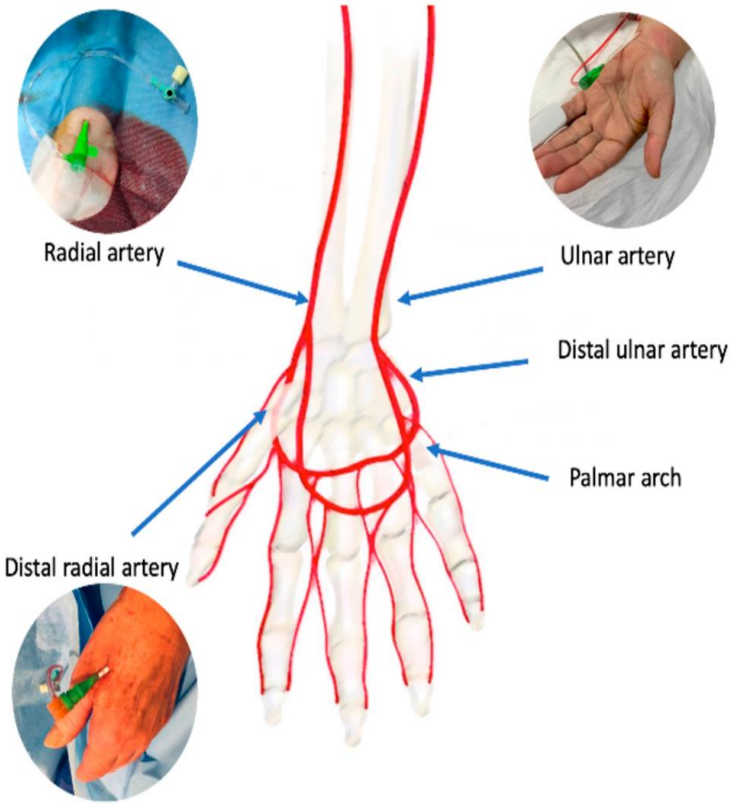
1.1.1 Theoretical definitions

- Ischemic heart disease: ischemic heart diseases are diseases that are caused by an obstructive plaque blocking the flow of blood through the coronary artery, which in turn, causes ischemia to the myocardium (Severino et al., 2020).
- Cardiac catheterization: cardiac catheterization is an invasive procedure that is performed by passing catheters into the left and/or right side of the heart to obtain diagnostic information about the heart itself or the blood vessel (Vefalı & Sarıçam, 2020). Potential arterial access sites in the hand and wrist are shown in Figure 1.
- Trans-radial cardiac catheterization: trans-radial cardiac catheterization is using the radial arteries to access the coronary artery and the heart (Coomes, Haghbayan, & Cheema, 2020).
- Cardiac catheterization complication: The complications of the cardiac catheterization include mortality while the patient in the hospital, occurrence of stroke, myocardial infarction, percutaneous coronary intervention owing to iatrogenic coronary dissection, pericardial effusion or tamponade, or a need for bypass surgery that was not expected within 72 h of diagnostic left heart catheterization (Al-Hijji et al., 2019).
- Pain: A definition of pain can be articulated as an emotional experience and a distressing sensory that can be linked to a damage to tissues. On the other hand, acute pain can be described as a temporary reaction to noxious stimulus that harms or threatens to harm tissues that otherwise healthy (Michaelides & Zis, 2019).
- Analgesics: Analgesics are medications that are used to diminish pain sensations without affecting the level of consciousness (van Rensburg & Reuter, 2019).

- Local anesthetics: Local anesthetics are agents that block sodium channels and reduce the propagation of the action potential of a nociceptive signal (Suzuki, Gerner, & Lirk, 2019).
- Vasodilators: Vasodilators are agents used to relax the smooth muscle around the blood vessels and cause them to dilate (Pewowaruk, Hein, Carlsson, Korcarz, & Gepner, 2022).
- Satisfaction: The degree to which the patient was satisfied with the medical procedure (trans-radial cardiac catheterization) (Khanna et al., 2019).
- Side effects: The adverse effects or any negative outcomes that could be attributed to the medical procedure (trans-radial cardiac catheterization) (Khanna et al., 2019).
- Lidocaine: A local anesthetic agent that blocks the sodium channels and reduces the propagation of the action potential of a nociceptive signal (Suzuki et al., 2019).
- Nitroglycerine: A vasodilator that is used to relax the smooth muscle around the blood vessels and cause them to dilate (Pewowaruk et al., 2022).

Figure 1

Potential arterial access sites in the hand and wrist



Note: Scalise et al., 2019

1.1.2 Operational definitions

- Measurement of pain intensity using the visual analog scale (VAS): The pain intensity as experienced by the patient during the trans-radial cardiac catheterization was assessed using the VAS on a 10 cm horizontal line with verbal descriptors at each end. On one-end, the scale is labeled as “no pain” and on the other end, the scale is labeled as “worst imaginable pain”. The patients were asked to mark a line on the VAS at the point that best described their pain they experienced during the procedure. The intensity of pain was measured by measuring the distance from the beginning of the scale to the point the patient has marked. Higher VAS score indicated higher experienced pain (Michaelides & Zis, 2019; Lazaridou, Elbaridi, Edwards, & Berde, 2018).
- Sympathetic responses: The sympathetic responses in terms of changes in heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation were measured as changes in readings on noninvasive techniques including digital pulse and blood pressure monitoring devices (Mukherjee, Ghosh, Gupta, & Chakravarty, 2018).
- Occurrence of radial artery spasm: Occurrence of radial artery spasm was measured as pain reported by the patient in the forearm during the procedure and worsened while moving the sheath/catheter, a felt difficulty in moving the catheter or a restriction to its progress, difficulty in removing the sheath at the end of the procedure, and/or a need for additional injections of vasodilators during the procedure (Talasaz et al., 2021).
- Satisfaction during the procedure: Satisfaction during the procedure was measured by observing the patient for throwing up or feeling like throwing up, wanting to have the same anesthetic again, feeling itching, feeling relaxed, feeling safe, feeling pain, and feeling hurt (Tezcan & Büyükterzi, 2024; Lindner, McNeely, & Amin, 2020; Khanna et al., 2019).
- Hand coldness: Coldness was measured by comparing between both hands for a difference in the temperature. This was measured as an indicator of hand ischemia (Aoun, L. Hattar, K. Dgayli, G. Wong, & T. Bhat, 2019).
- Hand weakness: Weakness was measured by handshaking with the patient and grasping their hand to assess for any weakness. This was measured as an indicator of dysfunctions as a result of the procedure or ischemia (Ul-Haq et al., 2017).

- Hand paleness: Hand paleness was measured by comparing between both hands for a difference in the paleness. This was measured as an indicator of ischemia or dysfunctions as a result of the procedure (Bigler et al., 2019).
- Hand pulselessness: Pulselessness was assessed at 4-6 h, when the TR BAND® radial compression device or crepe bandage was removed to determine if pulse was palpable or not (Parikh & Gilchrist, 2019).

1.2 Ischemic heart disease

Myocardial infarctions are medical emergency conditions in which a significant proportion of the blood supply to the myocardium is suddenly stopped (Thygesen et al., 2018). The blood supplies the cardiac muscles from the coronary arteries that branch off from the aorta which is a large artery. Myocardial infarctions occur as a result of a block to blood supply to the myocardium through the coronary arteries. In this case, the myocardial cells are subjected to harm and necrosis as a result of lack of blood supply and oxygen. It is noteworthy to mention that an interruption of the blood supply to the myocardial cells for more than 20 min can cause significant harm to these cells (Severino et al., 2020; Thygesen et al., 2018).

Over the years, understanding of the pathophysiology of ischemic heart diseases has evolved. Today, the pathophysiology of ischemic heart disease is regarded as a complex and multifaceted process than the classic simplistic, simple, or cause-effect event (Severino et al., 2020). It is noteworthy to mention that the proximal section of the coronary tree contains the epicardial coronary arteries. The diameter of this area ranges from 250 μm to 5 mm. The coronary arteries in this area exhibit capacitance and in normal conditions contribute little to the coronary vascular resistance. The epicardial arteries respond to flow and dilate in a proportionate manner to the blood flow. These arteries are also subjected to shear stress. The shear stress varies by heartbeat (Severino et al., 2020).

From the classic viewpoint of pathophysiology of ischemic heart diseases, blood flow to the heart through the coronary artery is obstructed by a plaque. This obstruction causes ischemia to the myocardium. In this viewpoint, presence of obstructive atherosclerotic plaque inside the coronary artery diseases that hinders the passage of blood to the myocardium defines coronary artery disease. It is now thought that a critical stenosis in the coronary artery can cause ischemia to the myocardium. Even with stenosis of the

coronary artery, blood flows to the myocardium can be maintained at rest to the point when a critical stenosis develops. Keeping blood flow to the myocardium is ensured through the process of autoregulation. In this regard, autoregulation is defined as the capacity to maintain blood flow to the myocardium at times of change in perfusion pressure. It is thought that when the atherosclerotic plaque builds up to block more than 70% of the luminal cross-sectional area causing a reduction of 50% of the coronary diameter, this can decrease the pressure of coronary perfusion. In this case, autoregulation can ensure basal blood flow to the myocardium at rest while the dilator reserve becomes compromised (Duncker & Bache, 2008). The patient in this case might remain non-symptomatic at rest. However, when the metabolic demands are high, for example during exercise, the blood flow might become insufficient (Severino et al., 2020; Duncker & Bache, 2008).

Patients who complain of stable ischemic heart diseases can have a variety of symptoms, including classic angina, angina equivalents like dyspnea, or no symptoms at all. The wide range of symptoms begs the question of whether symptom status influences long-term prognosis. Revascularization is recommended by current asymptomatic ischemic heart disease guidelines and appropriate use criteria for the alleviation of symptoms that are not adequately controlled by medicinal therapy. Revascularization may be explored in asymptomatic individuals with high-risk illnesses, such as left main or multi-vessel disease, however, the majority of indications are unknown. It is unclear if this is related to an increased risk of injury or a perceived lack of benefit (Omair et al., 2020).

1.3 Ischemic heart disease epidemiology

Globally, cardiovascular diseases lead the causes of mortality (Severino et al., 2020; Elliott et al., 2019). According to some estimates, 17.8 million people died as a result of cardiovascular diseases in 2017 (Mensah, Roth, & Fuster, 2019). Epidemiological studies have reported inequalities in cardiovascular mortality between men and women and between people who reside in high-, middle-, and low-income countries (Mensah et al., 2019; Yuyun, Sliwa, Kengne, Mocumbi, & Bukhman, 2020). These studies have shown that ischemic heart diseases are 5-fold more common in male compared to female patients (Smaardijk et al., 2019). The risks of cardiovascular disease increased in women after reaching menopause. Moreover, women often develop cardiovascular diseases 10 years after men.

Cardiovascular disease accounts for about 33% of all fatalities worldwide. Of the cardiovascular diseases, ischemic heart diseases are the most frequent types. This ischemic heart diseases are widely regarded as a considerable hazard for long-term developments in the 21st century. Ischemic heart diseases, coronary artery diseases, or atherosclerotic cardiovascular diseases are a significant contributor to ischemic cardiomyopathies and myocardial infarctions (Elliott et al., 2019; Malakar et al., 2019). A considerable proportion of patients who live with ischemic heart disease often report poor health-related quality of life. It is well-established that atherosclerosis which is an inflammatory condition that affects the arteries. Once coupled with accumulation of bad cholesterol and metabolic changes as a result of different risk factors, this can lead to various pathological mechanisms and ischemic heart disease (Severino et al., 2020). It was estimated that about 705 of people are at risk for ischemic heart disease when having certain risk factors. In general, about 2% to 7% of the general population have no risk for ischemic heart disease. Because of the population aging, increased obesity, and prevalence of metabolic syndrome, there have been increases in the incidence rates of ischemic heart diseases.

1.4 Ischemic heart disease pathology

When occlusion occurs in the coronary artery, abnormalities in the mitochondrial functions are observed in about 10 min. Cardiac troponins are specific to the contractile tools in the myocardial cells. After the injury to non-cardiac tissues, no increases in cTnI levels have been documented. This can be complicated for cTnT. Damages to the skeletal muscles can be assessed using cTnT assays (Jensen et al., 2020; Milutinović et al., 2020)

Ischemic heart diseases continue to be a major issue and exert significant burdens on the health of patients and healthcare resources around the globe. Therefore, it is very important to study the pathophysiology of ischemic heart disease. Because of limitations to the flow and blockage of large- to medium-sized coronary arteries, this can be equated to atherosclerotic plaque. In normal circumstances, epicardial coronary arteries have capacitance roles and contribute by a little amount of coronary vascular resistance. During the physicality of coronary blood flow, epicardial artery responds to flow-dependent dilation and become subject to shear stress that varies with heartbeats. Vasodilation that is dependent on endothelial cells is responsible for the vasodilator effects of shear stress (Severino et al., 2020).

The endoplasmic reticulum produces lipid droplets, which are a type of subcellular organelle. Lipid droplets can switch between organelles and store energy in the cells. Lipid droplets and lipid droplet–associated proteins have received increased attention in recent years, particularly in the context of cardiovascular disorders, both at home and abroad. Because of their high morbidity and mortality, cardiovascular disorders, particularly ischemic heart disease, have traditionally been the focus of concern. ischemic heart disease is characterized by two major pathologic processes: atherosclerosis and myocardial remodeling, both of which are aided by lipid droplets and other organelles. In atherosclerosis, the interaction of lipid droplets is important in the production of foam cells. Lipid droplets, mitochondria, and lysosomes also influence cardiomyocyte remodeling via regulating PI3K/AKT and altering ROS generation (Jensen et al., 2020; Severino et al., 2020).

If the myocardial ischemia is severe and long enough, the myocardium dies, resulting in myocardial infarction. This can result in the heart failing to function as a pump or the electrical system failing, resulting in arrhythmias and sudden death. Aneurysms, ruptures, and/or valve abnormalities of the heart are other problems in those who survive. To date, reperfusion of the ischemic muscle is the only successful early treatment. Myocardial conditioning can help to delay and guard against the progression of myocardial infarction. As more is discovered about the molecular biology of the ischemic myocardium, researchers are hopeful that novel approaches to myocardial preservation and regeneration may emerge (Jensen et al., 2020).

1.5 Ischemic heart disease complication

The switch from myocardial ischemia to the development of heart failure are frequently sudden plaque-related events (Jensen et al., 2020). For example, erosions or ruptures causing thrombotic occlusions of the coronary artery in the epicardium. Clinically, these individuals frequently have an acute coronary syndrome, which can be classified as having or not having elevations in the ST wave-segment on electrocardiogram, and then further split into those with and without myocardial infarctions cardiovascular troponin efflux necrosis. The side of the infarcted myocardium, the development of mitral regurgitation, the region of the infarcted segment, and the presence of specific tachyarrhythmia. Acute ischemia causes the loss of functional cardiomyocytes, which results in myocardial shock and necrosis, as well as fibrosis, myocardial inflammations,

and hypertrophies. The changes can trigger a neurohormonal cascade that leads to negative left ventricular remodeling, which causes dilation and dysfunction in the non-infarcted myocardial. Heart failure development is facilitated by left ventricles remodeling, dilation, and ischemia mitral regurgitation. In the absence of acute coronary syndrome and an acute ischemic episode, the harmful consequences of chronic ischemia can undermine the integrity of cardiac tissue. Some patients can progress objective signs of myocardial ischemia like changes in the electrocardiograph if there is no any chest pain or angina-like symptom (i.e., asymptomatic myocardial ischemias). Patients with hypertension, diabetes, heart transplant denervation or a history of documented obstructive coronary artery disease are more likely to develop this silent myocardial ischemia condition. Even after adjusting for demographic and heart failure risk factors, asymptomatic myocardial ischemias that can be defined as evidence for myocardial infarction on the electrocardiograph without clinical myocardial infarction after the baseline visit. These results were true in patients who were stratified by heart failure risk factors. Additionally, the risk of heart failure linked with asymptomatic myocardial ischemias was higher among the younger Patients less than 53 years old vs. older patients (Hadad, Puvanesarajah, & Deune, 2019).

1.6 Ischemic heart disease risk factors

Personal features, lifestyle choices, and other health problems that can damage the arteries and lead to arteriosclerosis are all linked to cardiovascular disease risk factors. Some of these factors, such as age and gender, cannot be changed, but patients must focus on preventing and regulating the other causes. The following are risk factors for ischemic cardiomyopathy and vascular disease in general (Jensen et al., 2020):

With age, the chances of having myocardial infarction increase. This increase can be noticed in men over 45 and women over 55. The actions of different mediators on the blood vessels account for the age difference between men and women when it comes to the commencement of increased risk.

- Smoking: Smoking increases the likelihood of having myocardial infarction by a large amount. It's one of the most common risk factors while also being one of the easiest to avoid.
- Hypertension: High blood pressure destroys arterial walls and speeds up the progression of atherosclerosis. Quitting smoking, decreasing weight, and exercising

are just a few methods to reduce blood pressure while simultaneously improving the health of your arteries.

- Diabetes. Increased blood sugar level has been linked to higher risks of myocardial infarction. Individuals must maintain appropriate blood sugar management, whether by pills or insulin injections. When it comes to regulating sugar levels, losing weight, eating a healthy diet, and exercising frequently can all assist.
- Hypercholesterolemia. Analytical testing should be used to track fat levels in the blood. Cardiovascular diseases have been associated with elevated levels of low-density lipoprotein cholesterol and triglycerides. Conversely, high-density lipoprotein cholesterol levels protect against myocardial infarctions. Increase the quantity of "good" cholesterol in your body by eating a nutritious diet and exercising regularly.
- Genetics. Angina pectoris or infarction (heart attack) in the family can indicate a genetic risk. If your family history includes men under the age of 55 or women under the age of 65 who have had a myocardial infarction, this should be considered. If an older family member has had an infarction, it is most likely attributable to natural aging rather than a genetic component.
- Sedentary behavior. Obesity, high blood pressure, and poor control of diabetes and cholesterol levels are all linked to a sedentary lifestyle. Regular physical activity has numerous advantages in terms of reducing these risk factors.
- Obesity: Obesity is becoming more frequent in today's society, and it exacerbates the other risk factors. Even a small amount of weight loss is advantageous to the cardiovascular system.
- Stress. Stress and anxiety stimulate hormonal systems that can damage arteries over time.
- Drugs. Some medications, such as cocaine or amphetamines, can alter the way the arteries' function and create a vascular spasm, in which the artery contracts and blood flow is stopped. Cocaine abuse is a somewhat prevalent cause of heart attacks, particularly among the young.
- Pre-eclampsia. Women who have pre-eclampsia or autoimmune illnesses during pregnancy may have a higher risk of having a subsequent infarction.

1.7 Ischemic heart disease signs and symptoms

Pain in the chest is a symptom of conditions related to the heart, lungs, stomach and intestines, muscles, and skeleton, as well as mental disorders, all of which require distinct treatments. Because of the considerable mortality and morbidity associated with coronary diseases, in the event of chest discomfort, it is considered a sings of coronary artery disease to detect the early treatment for the life-threatening condition. Patients who complain of the following signs and symptoms may complain of coronary artery diseases or ischemic heart diseases: chest discomfort may be radiating (to the left or right arms and shoulders, neck, back, or epigastric), sweating, nausea, vomiting, oppressive pain, and non-attendance of chest-wall on palpation (Jensen et al., 2020).

1.8 Ischemic heart disease diagnosis

Each patient's clinical information, demographics, and hospital course after enrolment were recorded by evaluation of medical records by persons who were blinded to all biomarker results. The information examined includes records of the pertinent electrocardiograms, the emergency department evaluation (electrocardiogram), heart catheterization, stress testing, echocardiography data, medical history, and physical examination results documentation from the hospital, and discharge summaries. New ST wave-segment ST-segment depression of one mm or more in two contiguous leads, increase of one mm or more in 2 contiguous leads, new left bundle branch block, and T-wave inversions of three mm or more in two contiguous leads were utilized to confirm myocardial ischemias (Jensen et al., 2020; Severino et al., 2020).

Biomarkers are becoming better recognized for their clinical utility in the early detection and progression of many cardiovascular illnesses. Many illnesses of the heart, such as ischemic heart diseases, congestive heart failure, diabetic cardiomyopathy, and cardiac remodeling, have cardiac biomarkers that reflect the severities of the cardiac pathologies. From suspected acute myocardial infarctions, acute coronary syndromes, or in the emergency department with elevated cardiac marker: troponin. This can help in the diagnosis of some cardiac illnesses including heart failure. Because of their clinical significance in practice, newer biomarkers have been discovered. These biomarkers include the soluble sources of galectin-3, growth differentiation factor-15, tumorigenicity 2, and other different micro ribonucleic acids. As a result, multi-marker techniques involving different combinations of new cardiac biomarkers, as well as ongoing cardiac

biomarkers assessment are likely to enhance prediction of cardiac risks, patient stratification, and the overall well-being of the patients. On the other hand, these biomarkers could indicate isolated or concurrent disease processes in different organ systems other than the heart. As a result, understanding of cardiac biomarkers is very important. The importance of cardiac biomarkers, their use in clinical practice to make diagnosis, and predict the prognosis of different cardiovascular diseases have been a subject to an increasing volume of research activities (Jensen et al., 2020; Severino et al., 2020; Aoun, L. Hattar, K. Dgayli, G. Wong, & T. Bhat, 2019).

1.9 Treatments of ischemic heart diseases

Stable ischemic heart diseases can be managed using revascularizing with percutaneous coronary interventions, coronary artery bypass grafts, guideline-guided medication therapy, and initiation of medication therapy. The main purpose of these treatments is to help patients feel better and/or live longer. A reduction in nonfatal cardiovascular events is also an objective, which will lead to enhanced survival and quality of life. Many studies have been conducted to see if routine revascularizations improve prognosis in stable ischemia heart diseases. In patients with ischemic cardiomyopathies and patients who have symptoms of acute coronary syndrome, clinical trials have demonstrated that regular revascularization had a lower mortality rate than initial conservative treatment. The evidence to support routine revascularizations in patients with stable ischemia heart disease and intact ejection fraction, on the other hand, has been hotly debated. In a clinical trial, compared to initial medical therapies, percutaneous coronary intervention did not decrease the primary outcomes of mortality and myocardial infarctions. In another clinical trials, individuals with advanced coronary artery diseases, revascularizations reduced myocardial infarction and severe adverse cardiovascular events. These conclusions were owned to a considerable decrease in urgent revascularizations. In a recent clinical trial, initial invasive strategies were reported to show an early risk and a late benefit, but no overall difference in the primary outcomes when compared to initial conservative strategies. In another clinical trial, an initial invasive technique did not show a reduction in the risk of the primary outcomes (myocardial infarctions or mortality) in patients with advanced chronic kidney disease. So far, no trial has demonstrated that revascularization in stable ischemic heart disease reduces mortality. Individual trials, on the other hand, have a poor capacity to predict mortality, which is uncommon in

individuals with stable ischemic heart disease (Jensen et al., 2020; Hadad et al., 2019; Malakar et al., 2019).

1.10 Ischemic heart disease prevention

In low- and lower-middle-income nations, there are three significant priority areas for reducing ischemic heart disease mortality among persons with low socioeconomic status are, acute coronary treatment, cardiac rehabilitations, and secondary preventions are the first three steps, followed by primary prevention. The lack of knowledge about the symptoms among the patients and primary care doctors, the delay in reaching care establishments, the lack of coronary revascularizations and thrombolysis, and the cost of expensive medications (anti-platelets, statins, renin-angiotensin antagonists) all contribute to higher death rates in low-income patients with the acute coronary syndromes. Ischemic heart diseases' care requires hospitals for ease of accessibility, rapid diagnosis, and affordable long-term care. It is necessary to place a heavy emphasis on the socioeconomic predictors of health (living and working conditions, poor education, and poverty), increased healthcare costs, and effective primary healthcare. With attempts to remove trans-fats, cigarettes, minimize refined carbohydrates, alcohol, and salt consumptions, and promote healthy meals and physical activities, it is possible to improve the quality of primary preventions. Primary care that focuses improving levels of lipids, blood pressure, and care of diabetes mellitus is required. Task sharing with electronic decision support systems, community health workers, and the use of statins can all help to lower risk factors and minimize ischemic heart disease. Finally, ischemic heart disease preventive training for nurses, physicians, and other health professionals should be improved (Jensen et al., 2020; Hadad et al., 2019; Malakar et al., 2019).

1.11 Cardiac catheterization definitions

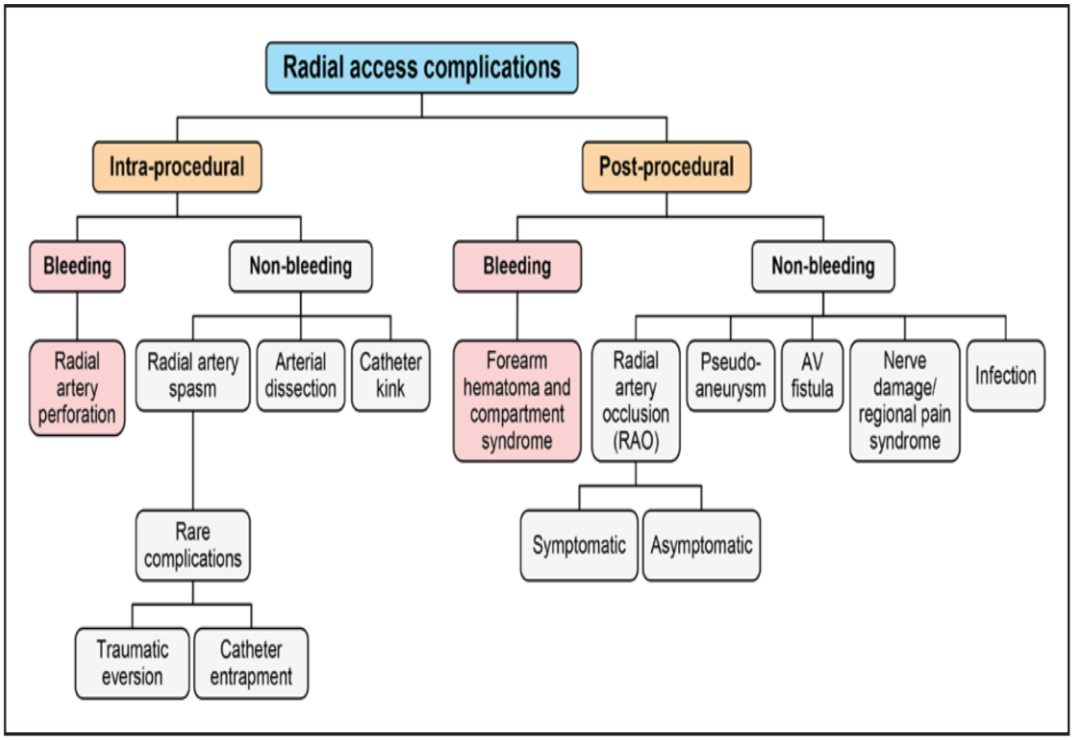
Cardiac catheterization is an intervention in which tubes which are known as catheters are inserted into arteries and veins that lead to the heart. This intervention is carried out to produce X-ray imagines of the chambers of the heart and the coronary arteries. During this process, pressures inside the heart are assessed. In cardiac catheterization laboratories, angiographies are used to take images not only for the coronary arteries, chambers of the heart, and making diagnosis of heart diseases, additionally, these images can be made for the aorta, pulmonary arteries, and peripheral blood vessels to screen for abnormalities. Moreover, cardiac catheterization laboratories use catheter-based

interventions including angioplasty with stent implantations, percutaneous coronary interventions, or catheter-based therapies for structural heart diseases in acute as well as chronic illnesses of the heart (Coomes et al., 2020; Biederman et al., 2016).

The process can be associated with several complications. A summary of the complications that can be associated with trans-radial cardiac catherization is shown in Figure 2.

Figure 2

Complications of trans-radial cardiac catheterization



Note: Sandoval, Bell, & Gulati, 2019

1.12 Cardiac catheterization prevalence

Approximately, more than 1 million patients require diagnostic coronary angiography are projected to be conducted in the US per year. Interventional cardiologists prefer the trans-radial approach over the trans-brachial, trans-femoral, and trans-ulnar approaches. This preference was motivated by the associated reduced all-cause death rates, cardiac death, bleeding, and other access site related complications (Coomes et al., 2020; Jensen et al., 2020; Jirous, Bernat, Slezak, Miklik, & Rokyta, 2020; Elliott et al., 2019; Hadad et al., 2019; Biederman et al., 2016).

1.13 Cardiac catheterization pain and management

In both elective and emergency circumstances, trans-radial access site has been introduced as the preferable route for coronary operations. Despite its relative ease, femoral artery cannulation is associated with higher problems, including bleeding, hematoma, pseudoaneurysms, and nerve injury. Radial access is safer and less prone to vascular problems than femoral access, and it has a higher rate of patient acceptability. The radial artery's modest diameter can make cannulation challenging, and several attempts may raise the risks of radial artery spasms. The prevalence of alpha-1 adrenergic receptors in the medial layer, on the other hand, can cause an overactive response to circulating catecholamines, raising the risk of spasms. As a result, moderate-to-severe pain during radial artery cannulation can hasten the onset of radial artery spasm. Radial artery spasm may be efficiently prevented by using a topical preparation that dilates the radial artery and relieves patient pain. We in this study try to use new anesthetic management by developing a new topical gel that contained three well-known ingredients: lidocaine, verapamil, and nitroglycerin. In a topical gel, we combined verapamil 15% as a vasodilator, lidocaine 5% as a local anesthetic, and nitroglycerin 2% as a vasodilator. A topical mixture of nitroglycerin and lidocaine helped expand the size of the radial artery in individuals having trans-radial cardiac catheterization in a prior investigation by Beyer et al. in my study I want to use this technique by mixing lidocaine with nitroglycerin versus lidocaine alone to decrease patient pain and increase patient satisfaction during a cardiac catheterization procedure (Coomes et al., 2020; Jensen et al., 2020; Jirous et al., 2020; Elliott et al., 2019; Hadad et al., 2019; Lazaridou et al., 2018; Antonopoulos et al., 2017; Biederman et al., 2016).

1.14 Cardiac catheterization pain assessment score

The study was conducted in 2017 to understand the patient response to pain and patient satisfaction during cardiac catheterization, the 11-point numeric rating scale was used to categorize patients' vocal responses, with zero representing "no pain" and 10 signifying the "worst pain ever possible." Blood pressure and heart rate were used to quantify discomfort in a continuous, natural manner. Patients' responses to two questions from the Press Ganey survey about pain control and staff responsiveness to comfort were used to determine overall satisfaction (Coomes et al., 2020).

1.15 Indication and mechanism of action

Lidocaine is a type of amide local anesthetics. Given its better safety attributes compared to prior local anesthetics, its use spread quickly from the time it was initially created. Local anesthesia is a popular usage of the medication. When intravenously injected, lidocaine can be utilized as an adjunctive to tracheal intubations during provision of airway care services, reducing hypertension secondary to laryngoscopy, and perhaps decreasing the incidence of hyperkalemia and myalgia. Lidocaine can also be used to treat certain types of cardiac arrythmias including acute ventricular tachydysrhythmias. Additionally, lidocaine can be used as an adjunctive to analgesic in the treatment of acute and chronic painful conditions (Cummins, 2007).

Lidocaine blocks sodium ion channels on the membrane of the nerve cells, thus stabilizing them and rendering them insensitive to painful stimuli. In an uncharged form, lidocaine molecules diffuse into the axoplasm crossing the neural sheaths prior to making a reaction with hydrogen ions. Inside the cell, the cations that result from the reaction bind to sodium ion channels to block them and prevent the depolarization of the nerve cell membranes. Lidocaine is considered a weak base. This can explain the rapid onset of action of lidocaine compared to the other local anesthetics that have higher pKa values. The efficacy of lidocaine can be decreased by inflammation. This can be explained by the acidosis that can lower the percentage of the unionized molecules of lidocaine. Additionally, in inflammatory conditions, the blood flow increases, thus, distributing and decreasing the concentrations of lidocaine. Moreover, the production of inflammatory mediators like peroxynitrite is increased. This mediator can interact and activate sodium ion channels (Cummins, 2007).

1.16 Radial artery spasm and nitroglycerin

Trans-radial access for interventional procedures has a growing amount of evidence to back it up in the presence of chemical and mechanical stress, vasoconstriction occurs. Radial artery spasms, which have been documented to occur at rates of up to 30%, continues to be a substantial challenge, resulting in patient discomfort, longer procedure times, greater radial artery occlusion rates, and higher femoral artery conversion rates. With experienced operators and sufficient patient preparation, radial artery spasm is reported to occur less frequently. Though there are a variety of techniques for lowering

radial artery spasm during trans-radial angiography, intra-arterial vasodilators have proven to be the most effective (Abdelazeem. et al., 2022; Beyer et al., 2013).

1.17 Radial artery occlusion

In clinical practice, rans-radial coronary catheterization is frequently employed. The trans-radial method has lower risks of vascular complications, results in less access site bleeding, and necessitates shorter hospital stays than trans-femoral cardiac catheterization. But it might result in radial artery blockage. radial artery blockage develops later on after thrombosis, which first happens at the puncture site (Coomes et al., 2020, Al-Hijji et al., 2019; Antonopoulos et al., 2017).

1.18 Related studies

A systematic review was conducted to review clinical trials that investigated the efficacy of using nitroglycerin to preclude spasms and occlusions of the radial artery in trans-radial cardiac catheterizations (Abdelazeem et al., 2022). Following trans-radial cardiac catheterizations, radial artery spasms were identified as one of the most frequent access sites and intra-procedural complications. Different studies have suggested that radial artery spasms can cause occlusion of the radial artery after trans-radial cardiac catheterizations. Therefore, preventing radial artery spasms can improve the success of trans-radial cardiac catheterizations and prevent further complications. The systematic review included clinical trials that investigated the effects of adding nitroglycerin to reduce radial artery spasms and radial artery occlusions during trans-radial cardiac catheterizations. In the included clinical trials, nitroglycerin was administered using different routes of administration, including intra-arterial, subcutaneous, and topical. The systematic review included 11 clinical trials that included 5,814 patients who underwent trans-radial cardiac catheterizations. The review showed that subcutaneous nitroglycerin was superior in reducing radial artery spasms and radial artery occlusions during trans-radial cardiac catheterizations. On the other hand, intra-arterial nitroglycerin did not result in a significant reduction of radial artery spasms and radial artery occlusions during trans-radial cardiac catheterizations. Additionally, topical nitroglycerin did not result in a significant reduction of radial artery spasms and radial artery occlusions during trans-radial cardiac catheterizations. The review suggested that nitroglycerin can be administered subcutaneously for trans-radial cardiac catheterizations. Adding

nitroglycerin can bring practical and cost-effective benefits to trans-radial cardiac catheterizations.

A clinical trial was conducted to investigate the effects of using topical nitroglycerin to cause a dilation to the radial artery before trans-radial cardiac catheterizations (Beyer et al., 2013). The study was conducted on the premise that trans-radial cardiac catheterizations offer many advantages over trans-femoral cardiac catheterizations, including reduced odds of bleeding, access-site complications, length of stay in the hospital, and costs associated with the procedure. Moreover, the clinical trial was also motivated by the fact that the small diameter of the radial artery limited the sizes of equipment that could be used to gain access during trans-radial cardiac catheterizations. The clinical trials assess the effects of topically administering nitroglycerin before trans-radial cardiac catheterizations. The primary end-point assessed and compared in the clinical trial was the change in the diameter of the radial artery. In addition, the occurrence of radial artery spasms and radial artery occlusions were used as secondary endpoints. In their clinical trials, a total of 86 patients were randomized to the intervention and placebo groups and 43 patients were assigned to each group. At baseline and before the trans-radial cardiac catheterizations, the patients underwent an ultrasound of the radial artery. The baseline clinical and demographic variables of the patients were not different. When the radial artery cross-sectional areas were compared, no significant differences were detected at the baseline in both groups. At the end of the trans-radial cardiac catheterization procedure, the radial artery cross-sectional area decreased in the placebo group and increased in the intervention group. The study concluded that the topical administration of nitroglycerin resulted in an increase in the diameter of the radial artery.

A clinical trial was conducted to investigate the effects of subcutaneous injections of nitroglycerin on the occurrence of radial artery occlusions after trans-radial cardiac catheterizations (Chen et al., 2018). Nitroglycerin was injected at the puncture site in the radial artery. The patients were randomly assigned to the placebo or intervention groups. Patients in the intervention group received subcutaneous injections of nitroglycerin (0.5 mL of 0.1%) at the puncture site of the radial artery. Before the trans-radial cardiac catheterization procedure, the patients underwent an ultrasound. Additionally, the patients underwent a second ultrasound 24 h after the trans-radial cardiac catheterization procedure. The study was completed by 182 patients. The clinical and demographic

variables of the patients were similar in both groups. The diameter of the radial artery was significantly larger in the treatment group compared to the placebo group. Moreover, the occurrence of radial artery occlusions was significantly lower in the treatment group compared to the placebo group. The occurrence of radial artery pseudoaneurysms and hematomas was not statistically different between the groups. Intolerable headaches and episodes of hypotension were not reported among the patients in the intervention group.

A study analyzed the experiences of the operators on the effects of nitroglycerin on the occurrence of radial artery spasms during trans-radial cardiac catheterizations (da Silva et al., 2023). The study analyzed the effects of adding nitroglycerin to prevent radial artery spasms and improve trans-radial access on the basis of experiences of the operator. The patients (*n = 2,040*) in the study received either placebo or nitroglycerin (500 μg). Overall, the findings of the study showed that the use of prophylactic nitroglycerin did not reduce the occurrence of radial artery spasms compared to the placebo. However, nitroglycerin significantly reduced the occurrence of radial artery spasms during the trans-radial cardiac catheterizations that were performed by the experienced operators. The study concluded that the experience of the operator that counted in reducing radial artery spasms.

A single-center, double-blind, and randomized study was conducted to investigate the use of a topical gel that combined lidocaine with nitroglycerin and verapamil for trans-radial angioplasty (Mikailimirak et al., 2021). The study compared the effects of the gel on the diameter of the radial artery and pain during the procedure. The patients in the intervention group received 1 cm of the gel that was applied topically to the radial styloid process. The patients in the intervention and placebo groups underwent ultrasound. Pain was assessed using the visual analog scale (VAS). Changes in the sympathetic response were assessed as changes in the blood pressure (systolic and diastolic) as well as changes in the heart rate. Radial artery spasms were recorded as defined in the radial artery spasm scoring system. A total of 60 patients were included and randomly assigned to each group (30 patients were assigned to each group). The findings showed a significant increase in the diameter of the radial artery of the patients in the intervention group compared to their peers in the placebo group. The patients who received the gel reported significantly less pain during the radial puncture compared to the patients in the placebo group. Radial artery spasms were not recorded in any of the groups. The study concluded that

administration of the gel before the procedure can increase the diameter of the radial artery and reduce procedural pain.

A prospective study was conducted to assess the incidence of radial artery occlusions following trans-radial coronary catheterizations (Sadaka, Etman, Ahmed, Kandil, & Eltahan, 2019). In their study, a total of 164 patients were included. The radial artery was assessed using doppler ultrasonography on day 1 and 6 months after the trans-radial coronary catheterization procedure. On day 1, radial artery occlusions were detected in 32.9% of the patients. Six months after the trans-radial coronary catheterization procedure, radial artery occlusions were detected in 29.9%. The study showed that radial artery occlusions were predicted by being a female, age, using manual compression, and the diameter of the radial artery. The study concluded that radial artery occlusions were a main complication of trans-radial coronary catheterizations.

A review assessed the complications that can occur during and after trans-radial cardiac catheterizations (Aoun et al., 2019). In their article, symptomatic and asymptomatic radial artery occlusions, arteriovenous fistulas, radial artery spasms, nonocclusive radial artery injuries, radial arterial perforations, radial artery pseudoaneurysms, granuloma formation, nerve damages, access-site bleeding, and regional pain were reviewed as complications.

1.18.1 Radial artery occlusions

Previous studies have reported that the incidence rates of asymptomatic radial artery occlusions ranged from 1% to 30%. Because of their asymptomatic nature, the incidence rates varied greatly between studies. Similarly, the variability of the incidence rates could also be explained by the sensitivity of the diagnostic methods. Because of the increasing need for trans-radial cardiac catheterizations, arterio-venous fistulas for hemodialysis, and coronary artery bypass grafts, there is also an increasing need for maintaining the patency of radial arteries. The previous studies have suggested compressive strategies for radial artery after trans-radial cardiac catheterizations as interventions to reduce radial artery occlusions. The concept of these strategies lies providing force to compress the radial artery and avoiding the formation of hematomas. The use of anticoagulants was also suggested as another strategy. The anticoagulants used, included heparin, enoxaparin, and bivalirudin. Additionally, using ultrasound guided access for the radial

artery also decreased the number of attempts and the damages that could be caused by the repeated attempts. This reduction in the number of attempts was also shown to be associated with decreased incidence of radial artery occlusions. Similarly, the diameter of the sheath was also shown to affect the incidence rates of radial artery occlusions. There was a positive relationship between the sheath diameter and the incidence of radial artery occlusions. On the other hand, there was a negative association between the incidence of radial artery occlusions and the duration of compression. Similarly, the use of pression devices also was shown to reduce the incidence of radial artery occlusions and bleeding.

Moreover, the use of vasodilators and statins was also shown to be associated with lower incidence of radial artery occlusions. Similarly, the use of ipsilateral ulnar compression was also proven effective and inexpensive method to reduce the incidence of radial artery occlusions.

1.18.2 Injuries to the radial artery

The studies reviewed also reported the occurrence of injuries to the radial artery. These injuries can be associated with damages to the vessel layers including occurrence of medial inflammation, calcification, intimal hyperplasia, and necrosis of the adventitia. Damages to the radial artery also include tears and dissections. These damages can also impair the patency of the artery and change the responses to the vasodilatory mediators.

Previous studies have suggested that the re-use of radial arteries through which a catheterization was performed should be delayed for 3 months or more after the procedure because these arteries could be inflamed. The inflammatory responses would need time for the cascade to settle down and the endothelial cells to regain full functions.

1.18.3 Radial artery spasms

Radial artery spasms are one of the most frequent complications after trans-radial cardiac catheterizations. The incidence rates of radial artery spasms were reportedly to range from 25 to 30%. The occurrence of radial artery spasms can affect the ability of the interventionalists to perform trans-radial cardiac catheterizations. Moreover, the occurrence of radial artery spasms can result in failure of about 10% of the trans-radial cardiac catheterization procedures. This can increase costs, care time, and exposure to

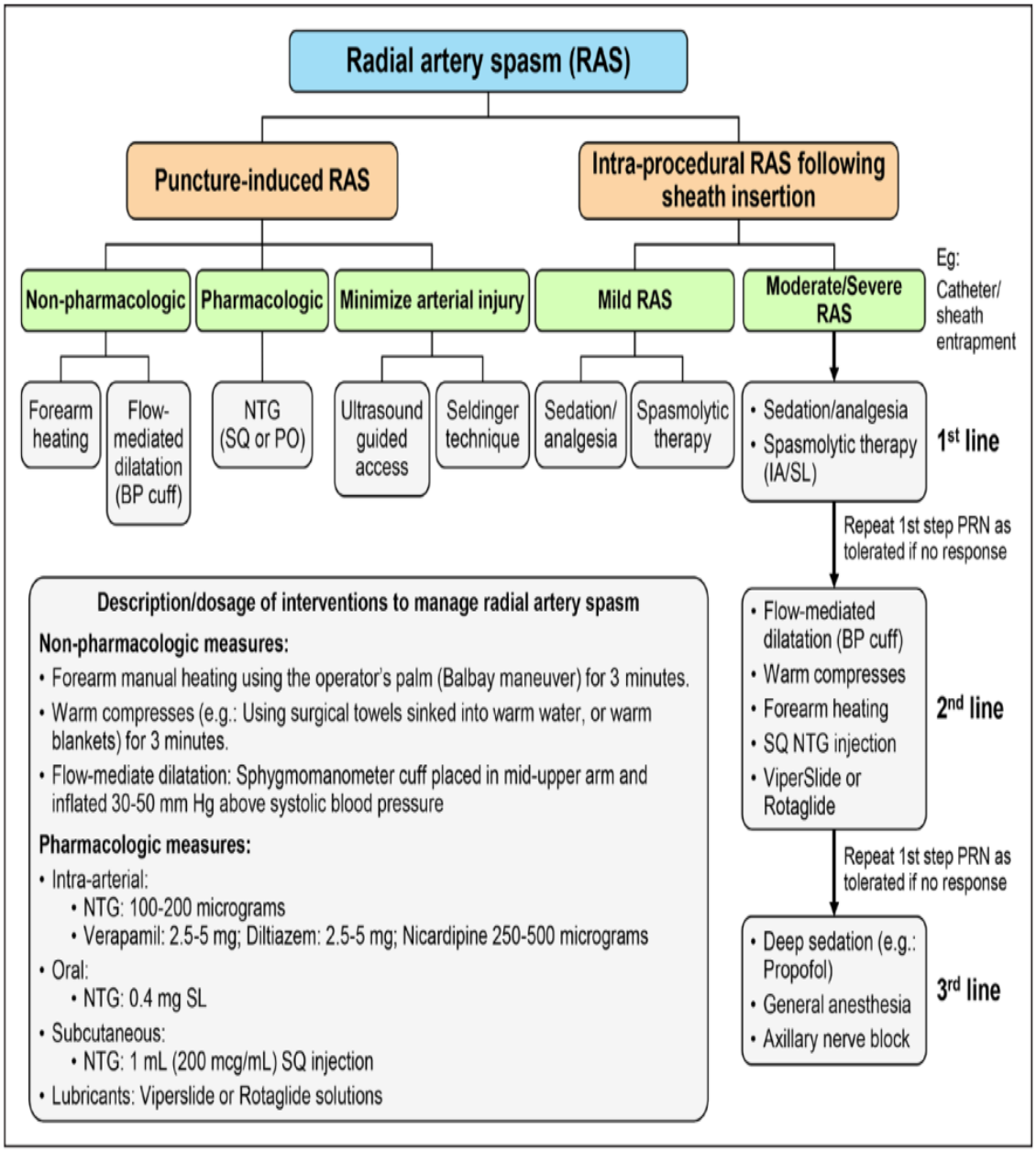
radiations. Probably, catecholamines can play key roles in the pathophysiology of radial artery spasms though binding to and activating alpha-1-adrenoreceptors. Otherwise, radial artery spasms are sudden and temporal narrowing of the radial arteries. These spasms can also be associated with pain that would exacerbate by moving the catheter. In some cases, complete entrapment of the catheters was also reported. Although perforation and dissection of the radial artery can be diagnosed or excluded by angiography, this diagnostic procedure is rarely performed in clinical practice.

Previous studies have reported different risk factors to adial artery spasms. These risk factors include reduced diameter of the radial artery, using large and non-hydrophilic sheaths, multiple access attempts, exchange of catheters, lengthy procedures, inexperienced operator, being a female, younger age, having diabetes mellitus, and lower body mass index.

Radial artery spasms can be managed using different strategies, these strategies are shown in Figure 3.

Figure 3

Strategies used to manage radial artery spasms



Note: Sandoval et al., 2019

The strategies used to reduce radial artery spasms included the use of analgesics, vasodilators, providing peri-procedural sedation, and patient education. Medications with vasodilatory effects included nitroglycerin, verapamil, nitroprusside, nicorandil, and phentolamine. Other novel approaches included pressure-mediated dilation. This method involved injection of saline solution with high pressure though the sheath. This method was suggested when the use of vasodilators was contraindicated. These contraindications included cardiogenic shock, aortic stenosis, and cardiac conduction disorders.

Other techniques included transitioning from sheaths to sheathless techniques. These techniques involve cutting the sheath when a spasm in the radial artery is encountered. This method was suggested when pharmacological interventions failed. Another alternative, Pigtail-assisted tracking was also suggested. The use of a lubricant was suggested to facilitate the extraction of sheath once entrapped by radial artery spasm. Other techniques including forearm warming by simple warm towels or surgical gauze soaked in warm liquids, like water, to using more advanced waring techniques like the use of air warming systems. These techniques were also suggested to facilitate the extraction of sheath once entrapped by radial artery spasm.

1.18.4 Perforation of the radial artery

Perforation of the radial artery was reported as a complication of the trans-radial cardiac catheterizations. The incidence rates of perforation of the radial artery ranged from 0.1% to 1%. Previous studies have reported that perforation of the radial artery is more likely to be encountered among elderly patients, notably women and those with small radial artery.

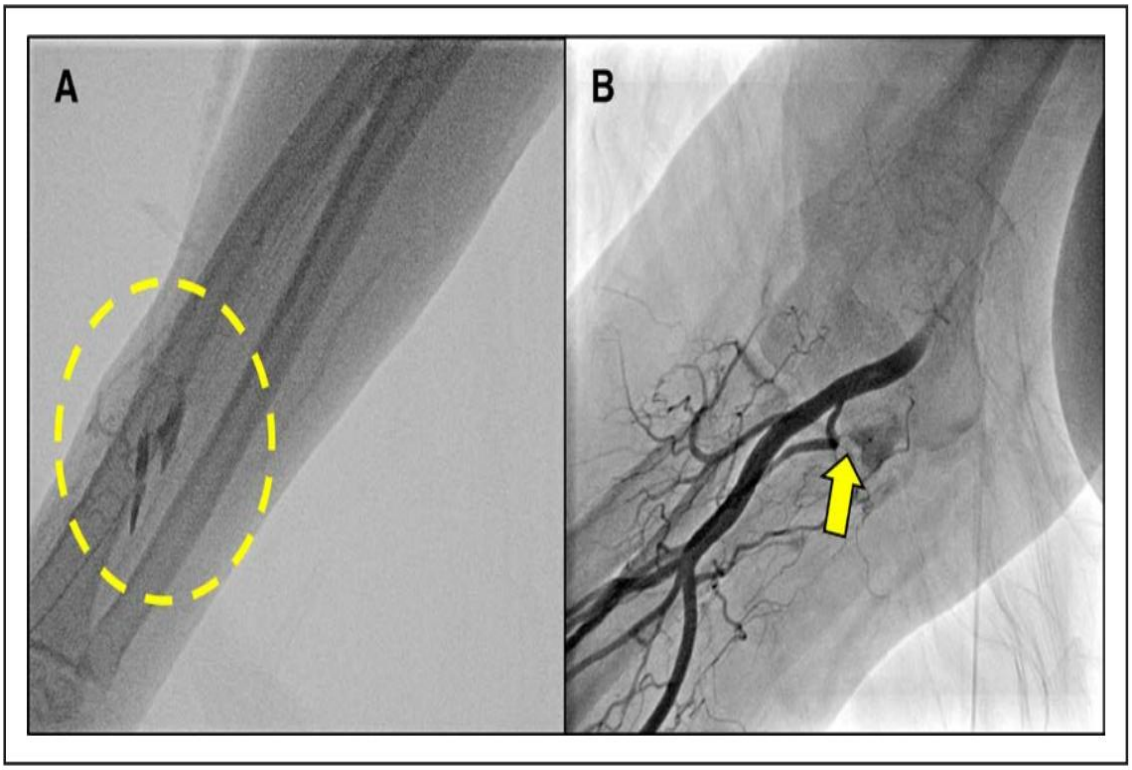
Interventionalists might encounter resistance while advancing the guide wire. The patients would also report pain in their extremities. Detection of perforation of the radial artery early enough can help avoid formation of large hematomas, limb ischemias, and compartment syndrome.

Previous studies have suggested that using the catheters themselves to tamponade the perforation sites can be used as therapeutic options in case of encountering perforation of the radial artery. It is also essential to repeat the radial arteriogram for ensuring the seal of the perforation.

The other techniques suggested included the use of peripheral balloons to cover the stents could also be used to cover the site of perforation. Additionally, manual compression was also suggested. A case of perforation is shown in Figure 4.

Figure 4

A case of extravasation of contrast (shown in circle) as a result of perforation and a perforation that is seen at a small artery as pointed to by the arrow



Note: Sandoval et al., 2019

Whitehead et al. (2020), Sedation and Analgesia for Cardiac Catheterization and Coronary Intervention, the authors examine the function of sedation in cardiac catheterization, including current practices and a summary of the available evidence for diagnostic and interventional coronary procedures in the cardiac catheterization laboratory. Sedation and pharmaceutical regimens are used in a variety of ways. The number of relevant studies available is limited, and they are usually tiny. In most trials, sedation appears to alleviate anxiety and pain to a minor extent. Procedural sedation lowers the risk of radial spasms and the necessity to change the access site as a result. The majority of available information pertains to the use of benzodiazepines and opioids, which appear to be acceptable efficacious, and safe when used with proper training and staffing; nevertheless, opioid medications impede the absorption of loading dosages of oral antiplatelet therapies. Finally, benzodiazepines and opioids are associated with a slight reduction in pain, increased patient tolerability, and a lower risk of radial artery spasms. Patient variables, such as the necessity for oral antiplatelet medication, should be considered when deciding whether to employ sedation and, if so, the agent(s) and dose to

utilize. Appropriate staffing and oversight are critical. And in this research, we want to study the effect of nitroglycerine to prevent radial artery spasm with a decrease in the usage of benzodiazepines and opioids because of its effect on oral anti-platelet therapies efficacy.

Hernández et al. (2022) association between variations in the combination of lidocaine and the prevalence of arterial spasm in procedures performed via radial access, Between October 2019 and February 2020, an experimental, analytical, cross-sectional study involving adult patients with an indication for le heart catheterization and/or angiography of the lower extremities or neck vessels treated with cine coronary arteriography, angiography of the neck vessels, angiography of the lower extremities, and/or angioplasty via radial access at the unit of hemodynamics from Hospital Municipal "Pedro Orellana", City of Trenque Lauquen, this study searched at a total of 83 adult patients who needed cardiac catheterization and/or angiography of the lower extremities or neck vessels and were treated with cardiac catheterization via radial access using Lidocaine alone in 32.5 of cases (n = 27), Lidocaine + Diltiazem in 33.75 % (n = 28), and Lidocaine + NTG in 33.75 % (n = 28). Patients ranged in age from 33 to 91 years old, with a mean age of 65.7 years (SD, 12.3). Male patients accounted for 53% of the cases (n = 44), with an average age of 64.8 years (SD, 12.3) ranging from 33 to 87. Female patents made up the remaining 47 percent (n = 39), with an average age of 66.7 years (SD, 12.3) ranging from 43 to 91 years. Only radial artery spasm was described in 25.3 percent (n = 21) of the patients who had a cardiac catheterization. There were no hematomas, edema at the access site, or thrombosis.

Table 1

Comparison of the prevalence of radial artery spasms among patients with different drug administration.

Comparison	Cases (%)	P
Lidocaine + NTG vs. Lidocaine + Diltiazem	3 (10.7) / 9 (32.1)	p=0.028*
Lidocaine + NTG vs. Lidocaine	3 (10.7) / 9 (33.3)	p=0.025*
Lidocaine vs. Lidocaine + Diltiazem	9 (33.3) / 9 (32.1)	p=0.461

1.19 Problem statement

Cardiac catheterizations are specific and complex procedures that are performed either as therapeutic or diagnostic approaches in ischemic heart disease and coronary artery disease (Vefalı & Sarıçam, 2020). Despite their undisputable benefits, they can also be associated with procedural and post-procedural complications including bleeding, hematoma, pain, radial artery spasms, and occlusion (Al-Hijji et al., 2019).

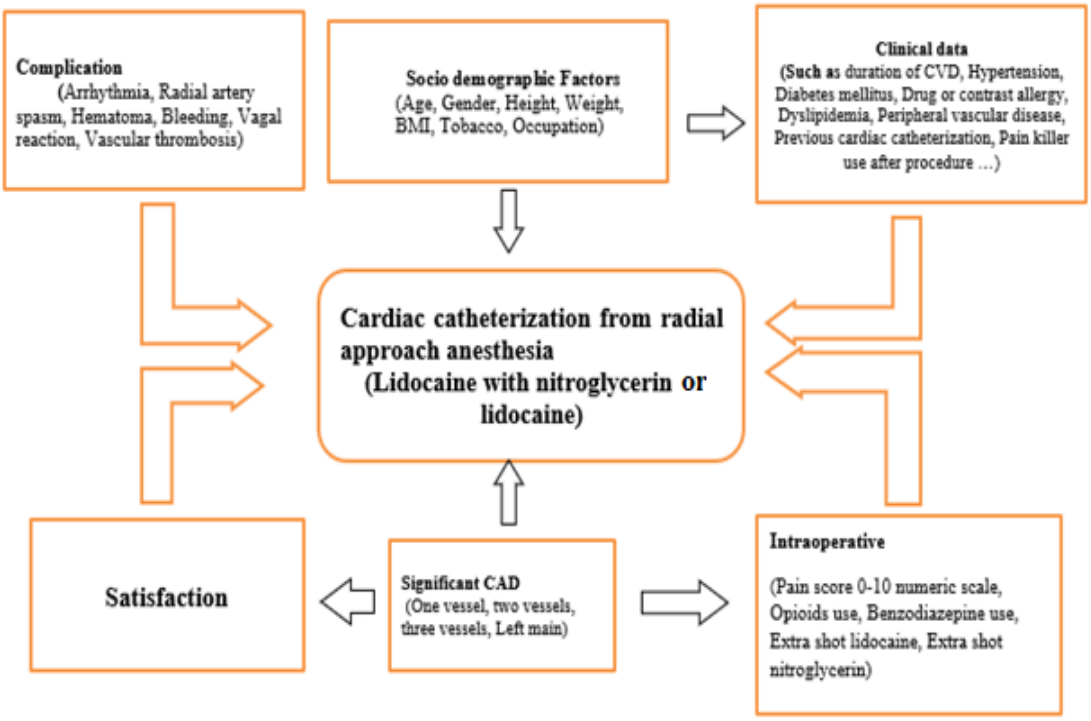
Previous studies have reported that patients who undergo trans-radial cardiac catheterization can suffer complications as a result of radial artery spasms and occlusion. Moreover, the patients often report pain and dissatisfaction with the procedure.

Therefore, this study was conducted to investigate the effects of adding nitroglycerin to lidocaine on the complications, pain, and satisfaction of patients undergoing trans-radial cardiac catheterization.

1.20 Conceptual framework

Figure 5

Conceptual framework diagram



1.21 Study questions

In this study, the research questions were:

- What are pain severity, satisfaction, and patient complications in lidocaine with nitroglycerin VS lidocaine among patients undergoing cardiac catheterization from a radial approach
- What is patient satisfaction during and post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin VS lidocaine
- What is the usage of analgesic post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin VS lidocaine?
- What is the difference between the usage of analgesic during cardiac catheterization from a radial approach among patients who received lidocaine with nitroglycerin VS lidocaine

1.22 General aim

To compare of pain severity, satisfaction, and patient complications in lidocaine with nitroglycerin VS lidocaine among patients undergoing cardiac catheterization from a radial approach

1.23 Specific objectives

The specific objectives of this study were:

- To compare lidocaine with nitroglycerin VS lidocaine in decreasing pain severity among patients undergoing cardiac catheterization from a radial approach
- To assess patient satisfaction during and post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin VS lidocaine
- To assess usage of analgesic post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin VS lidocaine
- To compare the usage of analgesic during cardiac catheterization from a radial approach among patients who received lidocaine with nitroglycerin VS lidocaine

1.24 Study hypotheses

The hypotheses of this study were:

- There is a significant difference between lidocaine with nitroglycerin VS lidocaine in decreasing pain severity among patients undergoing cardiac catheterization from a radial approach at $\alpha=0.05$
- There is a significant difference on patient satisfaction during and post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin VS lidocaine at $\alpha=0.05$
- There is a significant difference on patient complications in lidocaine with nitroglycerin VS lidocaine among patients undergoing cardiac catheterization from a radial approach at $\alpha=0.05$
- There is a significant difference on patient usage of pain killers post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin VS lidocaine at $\alpha=0.05$
- There is a significant difference on patient usage of another analgesic during cardiac catheterization from the radial approach among patients who received lidocaine with nitroglycerin VS lidocaine at $\alpha=0.05$

Chapter Two

Methods

This chapter outlines the methodology used in this study. In this chapter, the study design and setting, study patients, inclusion and exclusion criteria, sample size, patient selection, randomization, blinding, procedure, data collection, assessments, statistical methods, and ethical considerations are described.

2.1 Study design and setting

This study was conducted in a prospective randomized double-blind design among patients scheduled for trans-radial cardiac catheterization (Euser, Zoccali, Jager, & Dekker, 2009). The study was conducted in a single tertiary care hospital. This tertiary care hospital is one of the main referral centers for cardiac catheterizations in the north of the West Bank of Palestine.

2.2 Study patients

The study patients were those scheduled for trans-radial cardiac catheterizations in the tertiary care center. Patients who were 18 years and older and were scheduled for trans-radial cardiac catheterizations during the study period were potential candidates for inclusion in the study.

2.2.1 Inclusion criteria

In this study, the patients were included when they met all of the following inclusion criteria:

- Being 18 years or older
- Being scheduled for trans-radial cardiac catheterization
- Providing informed consent

2.2.2 Exclusion criteria

In this study, the patients were excluded when they met one of the following exclusion criteria:

- Patients with hemodynamic instabilities
- Patients admitted for emergency trans-radial cardiac catheterization

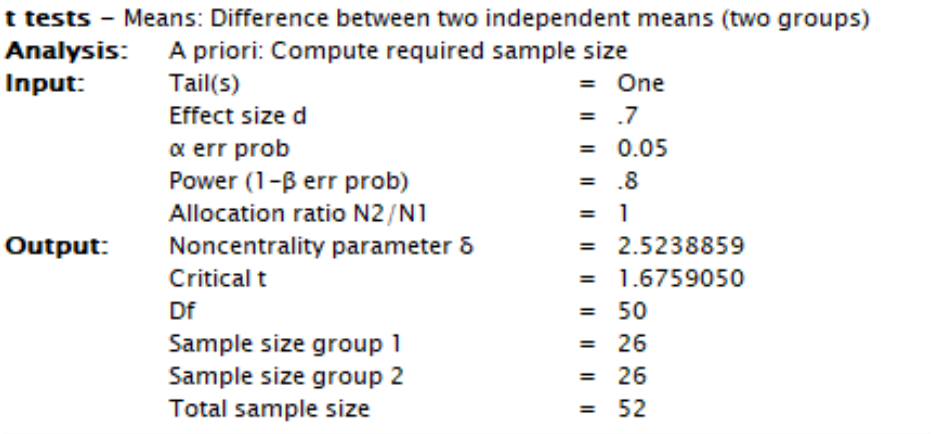
- Patients with cardiogenic shock
- Patients in whom nitroglycerin and lidocaine were contraindicated because of allergy or other reasons
- Absence or compromised flow of blood in the radial artery
- Presence of arterio-venous fistulae
- Pregnancy or breastfeeding

2.3 Sample size

The sample size was calculated using G*Power 3.1.9.7 for Windows (Heinrich Heine University Düsseldorf, Düsseldorf, Germany). To detect if there are differences in pain, complications, and other study variables, the sample size was calculated for a one tailed test using a power of 80%, an alpha of 5%, and a large effect size of 0.7. The sample size needed was about 30 patients in each group. For this study, the sample size was increased to 5 patients in each group. Details of the calculated sample size in G*Power 3.1.9.7 for Windows are shown in Figure 6.

Figure 6

Sample size calculation



2.4 Patient selection, randomization, and blinding

The patients were selected from the patients who were scheduled to receive trans-radial cardiac catheterization in the tertiary care center and met the inclusion criteria. Each patient was assigned a code. The codes were entered into a computer program and the program selected the patients randomly based on their codes. The patients were asked to sign an informed consent before receiving their trans-radial cardiac catheterization in the tertiary care center.

This study was double blind in which the patient and the interventional cardiologist were not aware of the anesthesia protocol. The researcher and the catherization laboratory technician were aware of the anesthesia protocol.

2.5 Procedure

The patients were assigned to receive either the intervention (Group A) or the standard treatment (Group B, control). The intervention consisted of subcutaneous 40 mg of lidocaine with 200 µg of nitroglycerin and intra-arterial 200 µg of nitroglycerin. The standard treatment (control) consisted of subcutaneous 40 mg of lidocaine and intra-arterial 200 µg of nitroglycerin. The assignment was made randomly.

2.6 Data collection

The data were collected from each patient using a standardized data collection form. The data collection form is provided in Appendix A. The following variables were collected.

2.6.1 Demographic data

The demographic variables of the patients like age, gender, marital status, smoking status, weight, height, and allergy to drugs or contrasts were obtained.

2.6.2 Past medical and surgical history

Additionally, the past medical and surgical history of the patients was also obtained. The variables collected included history of arterial hypertension, catheterization, dyslipidemia, diabetes mellitus, current clinical presentation, use of medications, and length of hospital stay.

2.6.3 Procedural data

Access site either right or left radial, heparin dose, nitroglycerin dose, and method of compression either TR band or Crepe bandage were also collected.

Moreover, the duration of the puncture, sheath size, procedural pain, duration of the procedure, occurrence of arterial spasm, and post-procedural pain were also collected. The duration of the puncture and procedure were measured in minutes using a hand-held timer by the researcher and the catheterization laboratory technician.

2.6.4 Pain assessment

The procedural pain was measured at the time of insertion of the introducer sheath into the radial artery. The visual analog scale (VAS) of 10 cm with verbal descriptions at the end was used to measure the intensity of the procedural pain (Lazaridou et al., 2018). The patients were asked to indicate the intensity of the felt pain by pointing to the 10 cm VAS.

2.6.5 Sympathetic responses

The sympathetic responses like heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation were also recorded at baseline before infiltration by lidocaine using noninvasive techniques including digital pulse and blood pressure monitoring devices. The same variables were also measured after the insertion of the sheath.

2.6.6 Radial artery spasm

The occurrence of radial artery spasm was assessed as absent or present based on the scoring system used in previous studies (Talasaz et al., 2021). The presence of radial artery spasm was considered when the patient reported pain in the forearm during the procedure and worsened while moving the sheath/catheter, a felt difficulty in moving the catheter or a restriction to its progress, difficulty in removing the sheath at the end of the procedure, and/or a need for additional injections of vasodilators during the procedure.

2.6.7 Satisfaction during the procedure

Satisfaction during the procedure was measured using the following items: 1) throwing up or felt like throwing up, 2) wanting to have the same anesthetic again, 3) felt itching, 4) felt relaxed, 5) felt safe, 6) felt pain, 7) felt hurt (Khanna et al., 2019; Lindner et al., 2020; Tezcan & Büyükterzi, 2024).

2.6.8 Satisfaction after the procedure

Satisfaction after the procedure was measured using the following items: 1) felt pain, 2) satisfied with the anesthesia care, and 3) felt good (Khanna et al., 2019; Lindner et al., 2020; Tezcan & Büyükterzi, 2024).

2.6.9 Assessment of complications

The occurrence of ischemia to the hand as paleness, coldness, weakness, and/or pulselessness were collected. Additionally, the occurrence of serious complications as stroke, myocardial infarction, and radial bleeding were also collected. Moreover, opioid use, benzodiazepines use, the need for extra lidocaine, and the need for extra nitroglycerin shots were also collected.

2.6.10 Assessment of hand coldness, paleness, pulse, and weakness

Hand coldness was assessed by comparing between both hands for differences in the temperature from the end of the trans-radial cardiac catheterization procedure until 4-6 h (until the removal of TR BAND® radial compression device or crepe bandage) (Aoun et al., 2019; Ying, Lin, Chen, Cao, & Yao, 2022).

Hand paleness was assessed by comparing between both hands for occurrence of or a difference in the paleness from the end of the trans-radial cardiac catheterization procedure until 4-6 h (until the removal of TR BAND® radial compression device or crepe bandage) (Bigler et al., 2019; Ul-Haq et al., 2017).

Pulselessness was assessed at 4-6 h, when the TR BAND® radial compression device or crepe bandage was removed to determine if pulse was palpable or not (Parikh & Gilchrist, 2019).

Hand weakness was assessed during the physical examination before and after the trans-radial cardiac catheterization procedure to compare the hand grasp power to assess for hand weakness (Bigler et al., 2019; Ul-Haq et al., 2017).

2.7 Statistical methods

The Statistical Package for Social Sciences Software (SPSS) Version 23 was used for the data analysis in this study. The researcher conducted descriptive statistics (frequencies, percentages, means, and standard deviations) for all the studied indicators and measurements. The statistical tests used to analyze the results and to test the research hypotheses assuming that the P-Value ≤ 0.05 is considered significant were:

- The Chi-Square test: tests the differences in percentages between the study groups for the qualitative variables such as: access site, intervention, method of compression,

gender, marital status, smoking, drug/contrast allergy, past medical history, current clinical presentation, use of medication, sheath size, occurrence of arterial spasm, satisfaction during and post radial approach cardiac catheterization, ischemia to the hand, serious complications, opioids use, and other used analgesic.

- Two independent samples t-test: test the differences in means between the study groups for quantitative variables such as: heparin dose, nitroglycerine intra-arterial, heart rate, O Sat, SBP, DPB, age, weight, height, length of hospital stay, post-procedural pain 1-10 scale, procedural pain 1-10 scale, procedure duration, and puncture duration.

2.8 Ethical considerations

The protocol and ethics of this study were approved by the Institutional Review Board of An-Najah National University. Additional permissions were obtained from the tertiary care center. In this study, all patients provided informed consent before they were enrolled in the study. The study approvals are provided in Appendix B and Appendix C.

Chapter Three

Results

This chapter presents the results obtained in this study. In this chapter, the demographics of the study patients are described. Additionally, the outcomes of both groups are described and compared.

3.1 The study patients

A total of 100 patients were selected randomly and distributed into two groups: 50 patients were allocated to Group A. The patients in Group A received 40 mg of lidocaine with 200 µg of nitroglycerin subcutaneously and 200 µg of nitroglycerin intra-arterial. Another 50 patients were allocated to Group B. The patients in Group B served as control and received 40 mg of lidocaine subcutaneously and 200 µg of nitroglycerin intra-arterial. The study objective was to compare the two study groups in terms of ischemia to the hand indicators, serious complications, patient satisfaction during and post radial approach cardiac catheterization, pain severity indicators, past medical history, and some diagnosis indicators. The average age of the patients in the study sample was about (59 years) with an average weight of about (82 kg), and an average height of about (169 cm). Of the patients in the study sample in both groups, 35 (70%) were male, 98 (98%) were married, and 60 (60%) were smokers.

Table 2

Comparisons between the study groups (A: Lidocaine with Nitroglycerin) and (B: Lidocaine) according to some diagnosis indicators (n = 100)[*]

Variable	Group		Total (*n = 100*)	P-value
	A (Lidocaine with Nitroglycerin) (*n = 50*)	B (Lidocaine) (*n = 50*)		
Access site				
Right Radial	48(96%)	43(86%)	91(91%)	0.081
Left Radial	2(4%)	7(14%)	9(9%)	
Intervention done				
None	30(60%)	30(60%)	60(60%)	0.999
Percutaneous coronary intervention	20(40%)	20(40%)	40(40%)	
Heparin dose	6800 ± 2424.37	7000 ± 2474.36	6900 ± 2439.16	0.684
Nitroglycerine intra-arterial	214 ± 63.92	212 ± 62.73	213 ± 63.01	0.875
Heart rate	76.18 ± 13.94	77 ± 14.26	76.59 ± 14.03	0.772
Oxygen saturation	96.88 ± 1.42	97.08 ± 1.52	96.98 ± 1.47	0.499
Blood pressure				
Systolic blood pressure	130.56 ± 13.43	133.7 ± 18.43	132.13 ± 16.12	0.333
Diastolic blood pressure	77.9 ± 8.97	78.38 ± 11.4	78.14 ± 10.21	0.816
Method of compression				
TR Band	31(62%)	30(60%)	61(61%)	0.838
Crepe Bandage	19(38%)	20(40%)	39(39%)	

Note. [*]The P-values are related to the Independent Samples T-test for Quantitative variables and the Chi-square test for Qualitative variables, the numbers in the table represent (Mean ± Standard deviation) or n(%).

The results in the table above showed that there were no significant differences at 0.05 level between the study groups (A and B) in all the diagnosis indicators shown in the table (access site, intervention done, heparin dose, nitroglycerine intra-arterial, heart rate,

oxygen saturation, systolic blood pressure, diastolic blood pressure, and method of compression) because all P-values corresponding to these measurements were larger than 0.05.

Table 3

Comparisons between the study groups (A: Lidocaine with Nitroglycerin) and (B: Lidocaine) according to some demographic information for the patients in the study sample (n = 100)[*]

Variable	Group		Total (*n = 100*)	P-value
	A (Lidocaine with Nitroglycerin) (*n = 50*)	B (Lidocaine) (*n = 50*)		
Age	58.62 ± 10.83	59.62 ± 10.15	59.12 ± 10.46	0.635
Gender				
Male	35(70%)	35(70%)	70(70%)	0.999
Female	15(30%)	15(30%)	30(30%)	
Marital status				
Married	50(100%)	48(96%)	98(98%)	0.153
Single	0(0%)	2(4%)	2(2%)	
Smoking	29(58%)	31(62%)	60(60%)	0.683
Weight	84.95 ± 14.58	78.81 ± 13.41	81.88 ± 14.27	0.031
Height	168.06 ± 9.14	169.48 ± 10.25	168.77 ± 9.69	0.466
Drug/contrast allergy	2(4%)	1(2%)	3(3%)	0.558

Note. [*]The P-values are related to the Independent Samples T test for Quantitative variables and the Chi-square test for Qualitative variables, the numbers in the table represent (Mean ± Standard deviation) or n(%).

The results in the table above showed that there were significant differences at 0.05 level between the study groups (A and B) only in the weight, the mean of patients' weights in Group A (Mean=84.95) was significantly higher than the mean of patients' weights in Group B (Mean=78.81), the P-value of the test was 0.031.

On the other hand, the results in the table above showed that there were no significant differences at 0.05 level between the study groups (A and B) in all the remaining

demographic information for the patients (age, gender, marital status, smoking, height, drug/contrast allergy) because all the P-values corresponding to these measurements were larger than 0.05.

Table 4

Comparisons between the study groups (A: Lidocaine with Nitroglycerin) and (B: Lidocaine) according to the past medical history (n = 100)[*]

Variable	Group		Total (*n = 100*)	P-value
	A (Lidocaine with Nitroglycerin) (*n = 50*)	B (Lidocaine) (*n = 50*)		
Arterial hypertension	40(80%)	36(72%)	76(76%)	0.349
Previous catheterization	33(66%)	31(62%)	64(64%)	0.677
Dyslipidemia	32(64%)	32(64%)	64(64%)	0.999
Diabetes	30(60%)	33(66%)	63(63%)	0.534
Current clinical presentation				
Stable Angina	26(52%)	28(56%)	54(54%)	0.688
Acute Coronary Syndrome	21(42%)	18(36%)	39(39%)	0.539
Use of medication				
Acetylsalicylic acid	40(80%)	33(66%)	73(73%)	0.115
ACE	6(12%)	6(12%)	12(12%)	0.999
Beta Blocker	28(56%)	33(66%)	61(61%)	0.305
Clopidogrel	21(42%)	23(46%)	44(44%)	0.687
Statins	38(76%)	38(76%)	76(76%)	0.999
Anticoagulant	6(12%)	7(14%)	13(13%)	0.766
Antiplatelet	24(48%)	19(38%)	43(43%)	0.313
Thrombolytic	1(2%)	1(2%)	2(2%)	0.999
Length of hospital stay	1.62 ± 0.73	1.7 ± 0.84	1.66 ± 0.78	0.611

Note. * The P-values are related to the Independent Samples T test for Quantitative variables and the Chi-square test for Qualitative variables, the numbers in the table represent (Mean ± Standard deviation) or n(%).

The results in the table above showed that there were no significant differences at 0.05 level between the study groups (A and B) in all the past medical history indicators (arterial hypertension, previous catheterization, dyslipidemia, diabetes, current clinical presentation, use of medication) because all the P-values corresponding to these measurements were larger than 0.05.

Table 5

Comparisons between the study groups (A: Lidocaine with Nitroglycerin) and (B: Lidocaine) according to the pain severity indicators (n = 100)[*]

Variable	Group		Total (*n = 100*)	P-value
	A (Lidocaine with Nitroglycerin) (*n = 50*)	B (Lidocaine) (*n = 50*)		
Puncture Duration	29.46 ± 20.32	28.34 ± 22.52	28.9 ± 21.35	0.795
Sheath size				
5 Fr.	0(0%)	2(4%)	2(2%)	0.153
6 Fr.	50(100%)	48(96%)	98(98%)	
Procedural pain 1-10 scale	3.32 ± 2.33	3.56 ± 2.33	3.44 ± 2.32	0.607
Procedure duration	29.24 ± 17.01	29.32 ± 15.15	29.28 ± 16.02	0.980
Occurrence of arterial spasm	2(4%)	5(10%)	7(7%)	0.240
Post procedural pain 1-10 scale	2.12 ± 1.75	2.46 ± 1.5	2.29 ± 1.63	0.299

Note. * The P-values are related to the Independent Samples T test for Quantitative variables and the Chi-square test for Qualitative variables, the numbers in the table represent (Mean ± Standard deviation) or n(%).

The results in the table above showed that there were no significant differences at 0.05 level between the study groups (A and B) in all the pain severity indicators (puncture duration, sheath size, procedural pain 1-10 scale, procedure duration, occurrence of arterial spasm, post-procedural pain 1-10 scale) because all the P-values corresponding to these measurements were larger than 0.05. These results encouraged the rejection of the first study hypothesis H_1 that there are significant differences between lidocaine with nitroglycerin compared to lidocaine in decreasing pain severity among patients undergoing cardiac catheterization from a radial approach at α=0.05.

Table 6

Comparisons between the study groups (A: Lidocaine with Nitroglycerin) and (B: Lidocaine) according to the Patient Satisfaction during and post radial approach cardiac catheterization (n = 100)[*]

Variable	Group		Total (n = 100)	P-value
	A (Lidocaine with Nitroglycerin) (n = 50)	B (Lidocaine) (n = 50)		
Satisfaction during radial approach[**]				
1) I threw up or felt like throwing up	42(84%)	41(82%)	83(83%)	0.790
2) I would want to have the same anesthetic again	45(90%)	40(80%)	85(85%)	0.161
3) I itched	39(78%)	31(62%)	70(70%)	0.081
4) I felt relaxed	43(86%)	38(76%)	81(81%)	0.202
6) I felt safe	49(98%)	47(94%)	96(96%)	0.307
8) I felt pain during surgery	24(48%)	19(38%)	43(43%)	0.313
10) I hurt	13(26%)	15(30%)	28(28%)	0.656
Total satisfaction during radial approach	255(73%)	231(66%)	486(69.4%)	0.049
Satisfaction post radial approach[**]				
5) I felt pain	18(36%)	12(24%)	30(30%)	0.190
7) I was satisfied with my anesthetic care	46(92%)	43(86%)	89(89%)	0.338
9) I felt good	44(88%)	40(80%)	84(84%)	0.275
Total satisfaction post radial approach	108(72%)	95(63.3%)	203(67.7%)	0.109
Total satisfaction	363(73%)	326(65%)	689(69%)	0.011

Note. * The P-values are related to the Chi-square test for Qualitative variables, the numbers in the table represent n(%).

**The total satisfaction during/post radial approach calculated in the table above based on the number of satisfied answers by multiplying the number of items by 50 for each group A and B. For example, the number of items that representing the Satisfaction During Radial Approach is 7, multiply 7*50 patients in group A=350, the total number of satisfied answers in group A during radial approach is 255, so the total percentage of satisfaction during radial approach = 255/350=73%.

The results in the table above show that there were significant differences at 0.05 level between the study groups (A and B) in the total patient satisfaction during radial approach cardiac catheterization, the total percentage of satisfaction in group (A) (73%) was significantly higher than the total percentage of satisfaction in group (B) (66%), the P-value of the test was 0.049. This result encouraged the acceptance of the study hypothesis $H_{2.1}$ that there are significant differences on patient satisfaction during radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin compared to lidocaine at α=0.05.

On the other hand, the results in the table above showed that there were no significant differences at 0.05 level between the study groups (A and B) in the total patient satisfaction post radial approach cardiac catheterization, the total percentage of satisfaction in group (A) (72%) was not significantly higher than the total percentage of satisfaction in group (B) (63%), the P-value of the test was 0.109. This result encouraged the rejection of the study hypothesis $H_{2.2}$ that there are significant differences on patient satisfaction post radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin compared to lidocaine at α=0.05.

Table 7

*Comparisons between the study groups (A: Lidocaine with Nitroglycerin) and (B: Lidocaine) according to the Ischemia to the hand indicators, Serious complications, and the other used analgesic (n = 100)**

Variable	Group		Total (n = 100)	P-value
	A (Lidocaine with Nitroglycerin) (n = 50)	B (Lidocaine) (n = 50)		
Ischemia to the hand				
Pale	3(6%)	12(24%)	15(15%)	0.012
Coldness	1(2%)	8(16%)	9(9%)	0.014
Weakness	5(10%)	7(14%)	12(12%)	0.538
Pulseless	0(0%)	0(0%)	0(0%)	-----
Serious complications				
Stroke	0(0%)	1(2%)	1(1%)	0.315
MI	0(0%)	0(0%)	0(0%)	-----
Radial Bleeding	1(2%)	1(2%)	2(2%)	0.999
Opioids use	1(2%)	1(2%)	2(2%)	0.999
Extra shot lidocaine	2(4%)	5(10%)	7(7%)	0.240
Extra shot nitroglycerin	1(2%)	0(0%)	1(1%)	0.315
Benzodiazepine use	0(0%)	2(4%)	2(2%)	0.153

Note. * The P-values are related to the Chi-square test for Qualitative variables, the numbers in the table represent n(%).

The results in the table above showed that there were significant differences at 0.05 level between the study groups only in the ischemia to the hand complications (paleness and coldness), the P-values corresponding to these measurements were less than 0.05.

Regarding the ischemia to the hand complications (paleness), the results show that the percentage of patients in group (A) 3 (6%) was significantly lower than the percentage of patients in group (B) 12 (24%), the P-value of the test was 0.012. Also, regarding the ischemia to the hand complications (coldness), the results showed that the percentage of

patients in group (A) 1 (2%) was significantly lower than the percentage of patients in group (B) (p=16%), the P-value of the test was 0.014. These results encouraged the acceptance of the study hypothesis H_3 that there were significant differences in patient complications in lidocaine with nitroglycerin compared to lidocaine among patients undergoing cardiac catheterization from a radial approach at $\alpha=0.05$.

The results in the table above showed that there were no significant differences at 0.05 level between the study groups in opioids use 1 (2%) for both the study groups A and B, the P-value of the test was 0.999. The result encouraged the rejection of the study hypothesis H_4 that there were significant differences on patient usage of pain killers post-radial approach cardiac catheterization among patients who received lidocaine with nitroglycerin compared to lidocaine at $\alpha=0.05$.

The results in the table above also show that there were no significant differences at 0.05 level between the study groups in the extra shot lidocaine (4% in group A and 10% in group B), extra shot nitroglycerin (1 (2%) in group A and 1 (0%) in group B), and benzodiazepine use (0 (0%) in group A and 2 (4%) in group B), the P-values of the test corresponding to these measurements were higher than 0.05, encouraging the rejection of the study hypothesis H_5 that there were significant differences on patient usage of another analgesic during cardiac catheterization from the radial approach among patients who received lidocaine with nitroglycerin compared to lidocaine at $\alpha=0.05$.

Finally, the results in the table above showed that there were no significant differences at 0.05 level between the study groups in the weakness, pulseless, stroke, myocardial infarction, and radial bleeding, the P-value of the test corresponding to these indicators were higher than 0.05.

Chapter Four

Discussions and Conclusions

This chapter the results obtained in this study are discussed. A summary of the main results is provided. Additionally, the complications that occurred among the patients and satisfaction in both groups were compared. Control of potentially confounding factors was also discussed. Moreover, the strengths and limitations of the study are discussed. Moreover, a conclusion and recommendations are provided.

4.1 Summary of the main results

In cardiology practice, trans-radial cardiac catheterizations are largely accepted as safe and convenient invasive approaches (Aoun et al., 2019). Compared to transfemoral cardiac catheterizations, trans-radial cardiac catheterizations are considered safer. However, asymptomatic radial artery occlusions, radial artery spams, hematomas, and pain were previously reported as complications of this procedure. Therefore, there have been many attempts to improve this invasive approach and reduce the adverse effects that could be associated with this technique (Aoun et al., 2019). This single-center prospective randomized double-blind study was conducted to investigate and compare the effects of adding nitroglycerin to lidocaine compared to lidocaine for patients undergoing cardiac catheterization from a radial route. The intensity of pain, patient satisfaction, and adverse effects of both methods were compared. The findings of this study are informative to cardiologists and providers of invasive cardiology care techniques who might be interested in improving patient experiences and satisfaction with the care provided. Moreover, the findings of this study could add to those that were reported in previous studies investigating the potential effects of adding nitroglycerin to lidocaine to reduce complications and improve the safety and recovery of patients scheduled for trans-radial cardiac catheterizations (Abdelazeem. et al., 2022; Mikailimirak et al., 2021; Chen et al., 2018; Beyer et al., 2013; Lee, Wolfe, & Stone, 2013; Jolly, Niemelä, et al., 2011; Jolly, Yusuf, et al., 2011).

4.2 Differences in the complications between both groups

In this study, the addition of nitroglycerin caused significantly less paleness and coldness as an indication of causing less ischemia to the hand. These findings are significant and interesting. It is well-established that paleness and coldness are significant signs of poor or reduced blood perfusion to the hand during trans-radial cardiac catheterizations (Ying et al., 2022). Therefore, maintaining and improving blood flow to the hand is of paramount importance to prevent or reduce ischemia in the hand (Roy, Kabach, Patel, Guzman, & Jovin, 2022). It is noteworthy to mention that excessive ischemia can damage tissues and cause significant tissue necrosis. Moreover, paleness and coldness can be indicators of spasms and/or occlusions in the radial artery (Restrepo, Tabori, Sabri, Horton, & Sivananthan, 2022; Roy et al., 2022; Luther et al., 2021). The occurrence of spasms and occlusions can impair the patency of the radial artery and compromise the success of trans-radial cardiac catheterization. Therefore, the absence of paleness and coldness could be used as signs of adequate patency of the radial artery (Jirous et al., 2020). These findings are not surprising as nitroglycerin is a vasodilator (Abdelazeem. et al., 2022; da Silva et al., 2023). It is highly likely that the addition of nitroglycerin has further dilated the radial artery and improved its patency. This should ensure the passage of more blood to the tissues in the hand and reduce ischemia in the hand.

4.3 Differences in satisfaction between both groups

In this study, it was not surprising that the patients who received nitroglycerin in addition to lidocaine reported statistically significant higher satisfaction compared to the patients who received lidocaine. These findings can be explained by the potential improvements in comfort and safety by ensuring appropriate blood flow in the hand (Abdelazeem. et al., 2022; da Silva et al., 2023). Additionally, the addition of nitroglycerin was associated with significantly less paleness and coldness as indicators of hand ischemia. It is noteworthy to mention that hand ischemia causes pain, discomfort, damage, and/or necrosis in the hand tissues. Probably, the extended radial dilation and increase in the artery diameter caused by the addition of nitroglycerin could have increased the blood flow to the hand (Abdelazeem. et al., 2022). Moreover, the addition of nitroglycerin could also have reduced hand ischemia, radial artery spasms, and radial artery occlusions.

The additional benefits of adding nitroglycerin could also come from saving the time of the healthcare providers who might need to intervene to overcome radial artery spasms

and occlusions that might occur during the catheterizations. Moreover, reducing radial artery spasms and occlusions can make trans-radial cardiac catheterization safer and more comfortable for patients (Da Silva et al., 2023; Abdelazeem. et al., 2022; Chen et al., 2018).

to mention that trans-radial cardiac catheterizations were shown to be safer and associated with fewer adverse effects compared to trans-femoral cardiac catheterizations even in both male and female patients (Liebenthal et al., 2019).

In this study, the smoking status of the patients in both groups was similar. Matching the smoking status should also eliminate the risks that could be associated with being a smoker on the success rate and complications following trans-radial cardiac catheterizations. Many previous studies have reported that being a smoker was associated with a higher risk for bleeding following trans-radial cardiac catheterizations compared to being a nonsmoker (Buturak et al., 2016; Latsios et al., 2016). Moreover, smoking was also reported to be an independent predictor of bleeding events in patients undergoing trans-radial cardiac catheterizations. Similarly, being a smoker was also reported to be associated with higher access site vascular complications (Buturak et al., 2016). These negative effects could be explained by inflammation and dysfunctions caused to the endothelial cells by smoking (Latsios et al., 2016). Additionally, these effects could also be linked to the decreased response to the vasodilation of the radial artery caused by smoking (Buturak et al., 2016).

Similarly, the presence or absence of allergy to drugs and contrasts were also similar among patients assigned to the two groups. During trans-radial cardiac catheterizations, patients receive drugs and contrasts. These drugs include anticoagulants/antiplatelets, local anesthetics, analgesics, and vasodilators. The presence of allergy to these drugs and contrasts might affect the ability of healthcare providers to administer some drugs and contrasts to those patients. Moreover, healthcare providers might need to administer alternative drugs and/or contrasts. These alternative drugs and contrasts might bias the positive and/or negative outcomes of trans-radial cardiac catheterizations. Therefore, allergies to drugs and contrasts were accounted for in this study.

Although height might not be directly associated with the success rates and rates of complications following trans-radial cardiac catheterizations, however, weight or body

mass index might have an effect on the success rate and rates of complications following trans-radial cardiac catheterizations. In this study, the weights of the patients who were assigned to the intervention group were higher than those who were assigned to receive the control. Previous studies have shown that obese patients were at higher risk for bleeding and access site complications following trans-radial cardiac catheterizations compared to nonobese patients (Biederman et al., 2016; Hibbert et al., 2012; Honda, Fujimoto, Miyao, Koga, & Hirata, 2012). Therefore, assigning the intervention to the patients with higher weights should have protected against bias and should have demonstrated the impact of adding nitroglycerin to lidocaine for trans-radial cardiac catheterizations.

Similarly, there were no statistically significant differences in the past medical and surgical history, comorbidities, and medications used by the patients assigned to both groups. Once again, accounting for comorbidities and medications should also have eliminated the risk of bias associated with these factors. In this study, there was no significant difference in arterial hypertension between the patients in both groups. Hypertension is a well-known risk factor for cardiovascular diseases necessitating cardiac catheterizations. Although some previous studies did not show a difference in the success rate of trans-radial cardiac catheterizations among hypertensive and non-hypertensive patients, hypertension was associated with a higher risk of bleeding and access site complications (Buturak et al., 2016). Moreover, hypertension was also shown to be associated with smaller radial artery diameter. Small artery diameters can present technical and procedural challenges to interventional cardiologists and technicians while performing trans-radial cardiac catheterizations (Eker, Tuzuner, Yilmaz, Alanoglu, & Ates, 2009). Similarly, previous studies have reported a small increase in the risk of radial artery occlusion among patients who underwent previous trans-radial cardiac catheterizations. However, despite this slight increase in the risk, success rates of trans-radial cardiac catheterizations among patients with a history of previous catheterizations were not significantly affected (Buturak et al., 2016). In this study, there was no statistically significant difference in the number of patients with dyslipidemia in both groups. Like hypertension, dyslipidemia is a well-known risk factor for cardiovascular diseases necessitating cardiac catheterizations. Like hypertension, dyslipidemia is known to inversely affect the vascular health (Coomes et al., 2020; Aoun et al., 2019; Hadad et al., 2019). Studies focused on the effects of dyslipidemia itself on the success rates of

trans-radial cardiac catheterizations are limited (Coomes et al., 2020). Together with hypertension and dyslipidemia, diabetes deteriorates vascular health and increases the risk of bleeding, hematomas, and vascular access complications.

In this study, the numbers of patients who underwent trans-radial cardiac catheterizations for stable angina and acute coronary syndrome were similar in both groups. Previous studies have reported that procedural success rates were not different between patients who underwent trans-radial cardiac catheterizations for stable angina and acute coronary syndrome (J. Aoun et al., 2019; Hadad et al., 2019). However, the rates of complications among the patients who underwent trans-radial cardiac catheterizations for acute coronary syndrome were significantly higher compared to those who underwent procedures for stable angina. These complications included bleeding and hematomas (Hadad et al., 2019). Similarly, there were no statistically significant differences in the medications used by the patients who were assigned to both groups. Medications could impact the success rates and complications following trans-radial cardiac catheterizations. Bleeding, hematomas, and other access site vascular complications could be affected by medications (Mason et al., 2018).

4.4 Insignificant differences between both groups

When nitroglycerin was added to lidocaine, there were no significant differences in the duration of puncture, sheath sizes used, procedural pain, duration of the procedure, the occurrence of arterial spasms, post-procedural pain, and length of hospital stay. These findings indicated that the performed procedures were essentially similar and comparable. In a previous systematic review with meta-analysis that included 11 clinical trials, there was no significant difference in the duration of the procedures when nitroglycerin or the control were used (Abdelazeem et al., 2022). Similarly, in this study, there was no significant difference in the duration of puncture. The findings of this study were consistent with those reported in 11 clinical trials that were systematically reviewed (Abdelazeem et al., 2022). The studies reported no statistically significant differences in the number of attempts to puncture between nitroglycerin and the control. Moreover, there was no significant difference in major complications including myocardial infarction, stroke, or radial bleeding among the patients assigned to both groups. Similarly, there were no statistically significant differences in the use of opioids, extra lidocaine, nitroglycerin, or benzodiazepines among the patients assigned to both groups.

Taken together, these findings indicate that the addition of nitroglycerin did not increase the duration of the procedure or the puncture time. These findings might encourage invasive cardiologists and providers of trans-radial cardiac catheterizations to adopt this method.

4.5 Strengths of the study

This study has the following strengths:

- This was the first study to be conducted in Palestine to compare the effects of adding nitroglycerin to lidocaine on the complications and patient satisfaction following trans-radial cardiac catheterizations.
- This study was conducted in a prospective study design. Prospective studies are considered superior to retrospective studies. Additionally, prospective studies allow better data collection and control of the confounding factors.
- The study used an adequate and equal number of patients in both groups. The use of proportionate sample sizes in comparative groups should have improved comparability and reduced the risks associated with small sample sizes.
- Adequate matching and control of potentially confounding factors was applied in this study. These factors included demographic, disease, and procedural variables. This matching and control should have allowed the comparisons made in this study.
- The common complications associated with trans-radial cardiac catheterizations were screened for in this study. This screening should have allowed generating relevant data.
- Satisfaction of the patients was also assessed and compared in this study. Over the years, there has been an increasing emphasis on the satisfaction of patients with clinical and diagnostic procedures. These findings could be useful in guiding future practice in interventional cardiology.

4.6 Limitations of the study

This study has the following limitations:

- This was a single-center study. Compared to multicenter studies, the generalizability of the findings of single-center studies could be limited.
- Despite adequate sample sizes in each group, the findings could have been more reliable should we have included more patients in each group.

- Only one combination was compared to the standard lidocaine-nitroglycerin cocktail. A comparison of more cocktails could have been more interesting.
- A single dose of nitroglycerin was used in the intervention. The use of different doses could have generated more interesting data.

4.7 Conclusion

Based on the findings of this study, rejection or acceptance of the hypotheses are discussed below:

- Hypothesis 1: There was no significant differences in the procedural or postprocedural pain between both groups. Therefore, the null hypothesis would be accepted and the alternative hypothesis would be rejected.
- Hypothesis 2: The findings obtained in this study showed that adding nitroglycerin to lidocaine significantly increased patient satisfaction. Therefore, the alternative hypothesis would be accepted and the null hypothesis would be rejected.
- Hypothesis 3: The findings obtained in this study showed that adding nitroglycerin to lidocaine significantly decreased indicators of hand ischemia as indicated by reduced paleness and coldness. Therefore, the alternative hypothesis would be accepted and the null hypothesis would be rejected.
- Hypothesis 4: There was no significant differences in the use of pain killers after the trans-radial cardiac catheterization between both groups. Therefore, the null hypothesis would be accepted and the alternative hypothesis would be rejected.
- Hypothesis 5: There was no significant differences in the use of other analgesics during the trans-radial cardiac catheterization between both groups. Therefore, the null hypothesis would be accepted and the alternative hypothesis would be rejected.

The findings of this study demonstrated that adding nitroglycerin to lidocaine significantly decreased indicators of hand ischemia as indicated by reduced paleness and coldness. Additionally, adding nitroglycerin to lidocaine significantly increased patient satisfaction. There were no statistically significant differences or increases in puncture time and duration of the intervention. The findings reported in this study might be used by interventional cardiologists and other healthcare providers to improve the provision of trans-radial cardiac catheterization care by reducing complications and improving the safety and recovery of patients. Based on the findings of this study, interventional

cardiologists are recommended to add nitroglycerin to lidocaine to reduce hand ischemia and improve patient satisfaction.

4.8 Recommendations and implications of the findings

4.8.1 Implications for future practice

The findings of this study might be implicated in improving the care, safety, and recovery of patients undergoing trans-radial cardiac catheterizations. Interventional cardiologists might add nitroglycerin to lidocaine to reduce hand ischemia and satisfaction of the patients receiving trans-radial cardiac catheterizations in Palestinian hospitals.

4.8.2 Implications for future education

The findings of this study might be implicated in improving the education of interventional cardiologists and providers of healthcare services to patients undergoing trans-radial cardiac catheterizations in Palestinian hospitals on the benefits of adding nitroglycerin to lidocaine. Additionally, the findings might also be implicated in improving the education of patients about the procedure and possible complications of trans-radial cardiac catheterization.

4.8.3 Implications for future research

The findings of this study might stimulate future research on the effects of adding other vasodilators to the cocktail used in trans-radial cardiac catheterizations. Additionally, future studies might also be conducted to find the optimal dose of the vasodilators to be used in the trans-radial cardiac catheterization cocktail.

List of Abbreviations

Abbreviation	Meaning
SD	Standard deviation
SPSS	Statistical Package for Social Sciences
VAS	Visual analog scale

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Appendices

Appendix A

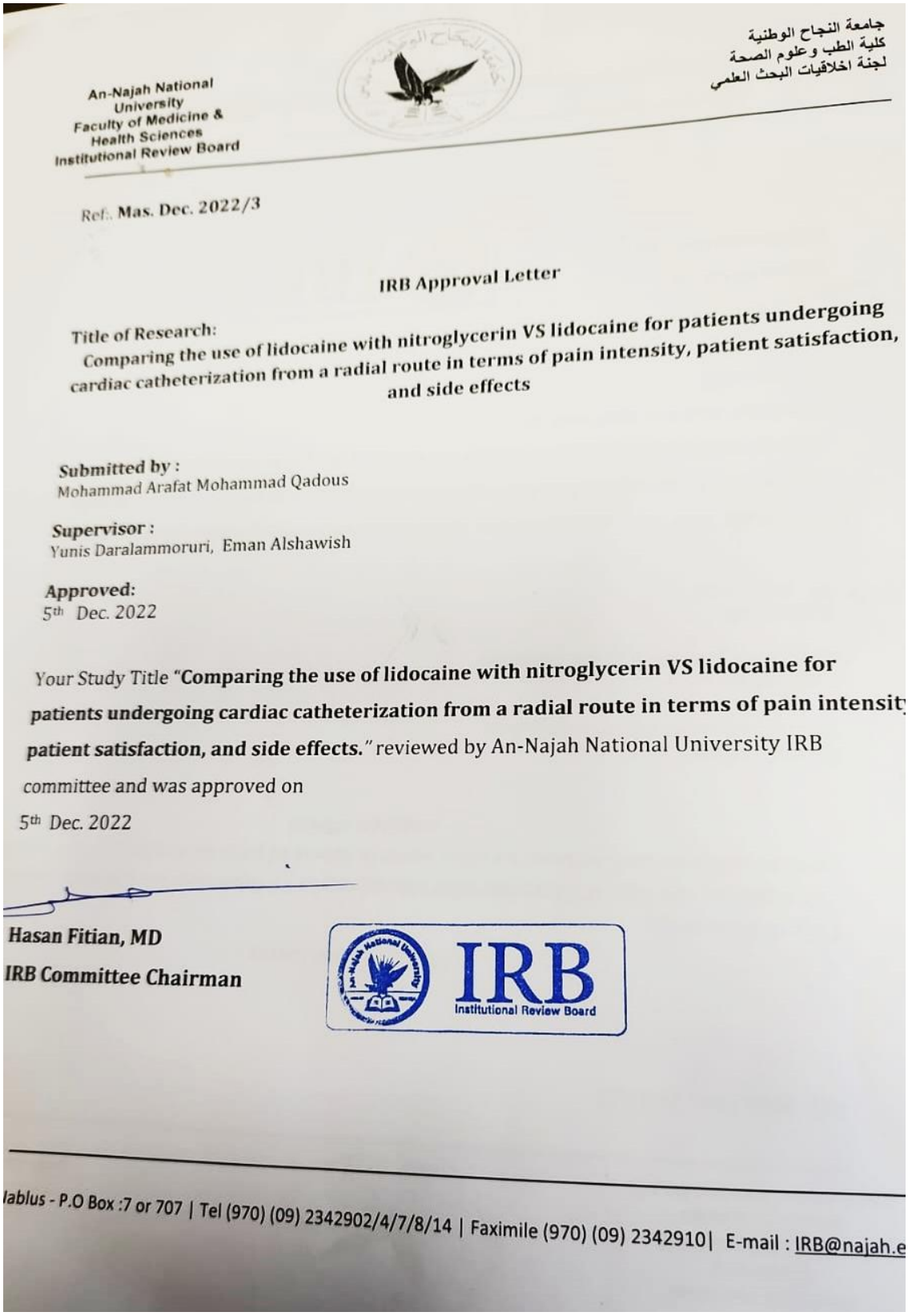
Data collection form

Patients Name			**Serial No.**			**Phone No.**		
Operator Name			**Amount of lidocaine2%**		cc	**Amount of nitroglicarine**		cc
Access Site	☐ Rt. Radial	☐ Lt. Radial	**Intervention done**			☐ none	☐ PCI	☐ PTCA
Indication of Angiography (Patient Diagnosis)	STEMI or NOT		**Puncture Duration** (from first attempt)			☐	☐	
Cross Over to?(if none state no)			Sheath size	4 Fr. 5 Fr. 6 Fr. 7 Fr.		**Procedural pain 1-10 Scale**		
Procedure Duration (from the point of successful puncture)			**Heparin dose**			**Occurrence of arterial spasm** Yes / No		
			Nitroglicarine intraarterial					
Heart Rate			**O Sat**	%		**Intra-Operative Complications**	☐ Arrhythmia	
Blood Pressure			**Method of Compression**			☐ TR Band	☐ Crepe Bandage	
NURSING								
Age	**Gender**	☐ M ☐ F	**Marital Satatus**		**smoking**		**drug/contrast allergy**	Yes ☐ No ☐
occubation	**Weight**		**Height**		**BMI**			
Past Medical History and Kidney Disease	☐ Arterial hypertension		☐ previous catheterization			**Current Clinical Presentation**	☐ Stable Angina	
	☐ Dyslipidemia		☐ Diabetes				☐ Acute Coronary Syndrome	
Use of Medications	☐ ASA	☐ ACE	☐ Beta Blocker			**Post Procedural pain 1-10 Scale**		
	☐ Clopidogrel		☐ Statins			**Length of Hospital Stay**		
	☐ Anticoagulant	☐ Antiplatelet	☐ Thrombolytics					
Ischemia to the Hand	☐ Pale	☐ Coldness	**Serious Complications**	☐ Stroke				
	☐ Weakness	☐ Pulseless		☐ MI				
Radial Bleeding	☐ Yes ☐ No		**Hematoma or Compartment** (EASY hematoma scale 1-5 if present)			**Extra shot lidocaine**	☐ yes	☐ No
Hematoma is defined by EASY hematoma scale. This scale has 5 grades:						**Extra shot nitroglycerin**	☐ yes	☐ No
Grade 1.	Local superficial hematoma							
Grade 2.	Hematoma with moderate muscular infiltration					**Opioids use**	☐ yes	☐ No
Grade 3.	Forearm hematoma and muscular infiltration below the elbow							
Grade 4.	Hematoma and muscular infiltration above the elbow					**Benzodiazepine use**	☐ yes	☐ No
Grade 5.	Compartment syndrome							

Patient satisfaction	**Agree**	**Disagree**
I threw up or felt like throwing up		
I would want to have the same anesthetic again		
I itched		
I felt relaxed		
I felt pain		
I felt safe		
I was satisfied with my anesthetic care		
I felt pain during surgery		
I felt good		
I hurt		

Appendix B

IRB approval



An-Najah National University
Faculty of Medicine & Health Sciences
Institutional Review Board

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Ref:. Mas. Dec. 2022/3

IRB Approval Letter

Title of Research:
Comparing the use of lidocaine with nitroglycerin VS lidocaine for patients undergoing cardiac catheterization from a radial route in terms of pain intensity, patient satisfaction, and side effects

Submitted by :
Mohammad Arafat Mohammad Qadous

Supervisor :
Yunis Daralammoruri, Eman Alshawish

Approved:
5th Dec. 2022

Your Study Title "**Comparing the use of lidocaine with nitroglycerin VS lidocaine for patients undergoing cardiac catheterization from a radial route in terms of pain intensity patient satisfaction, and side effects.**" reviewed by An-Najah National University IRB committee and was approved on
5th Dec. 2022

Hasan Fitian, MD
IRB Committee Chairman

IRB
Institutional Review Board

Nablus - P.O Box :7 or 707 | Tel (970) (09) 2342902/4/7/8/14 | Faximile (970) (09) 2342910| E-mail : IRB@najah.e

Appendix C

Study approval

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
دائرة التمريض

An- Najah National University
Faculty of Medicine & Health Sciences
Department of Nursing

التاريخ: 2022/12/13

حضرة السيد لؤي الزين المحترم / دائرة التمريض في مستشفى النجاح الوطني الجامعي ،،

الموضوع: تسهيل مهمة طالب الماجستير محمد عرفات محمد قادوس / ماجستير تمريض تخدير

تحية طيبة وبعد،

تهديكم دائرة التمريض والقائمه في كلية الطب وعلوم الصحه / جامعة النجاح الوطنية أطيب التحيات وتشكر لحضرتكم حسن تعاونكم معنا وترجو التكرم بالموافقه على تسهيل مهمة الطالب المذكورة أعلاه في مستشفاكم الموقر، حيث أنه سيقوم بعمل دراسة بغرض البحث العلمي لأطروحة التخرج من برنامج الماجستير تحت عنوان:

. Comparing the use of idocaine with nitroglycerin VS lidocaine for patients undergoing cardiac catheterization from a radial route in terms of pain intensity, patient satisfaction, and side effects

في الفترة الواقعه ما بين : 2023/6/1-2022/12/1

تحت اشراف: -

د. ايمان احمد شاويش

د. يونس دار عموري

- مرفق ملخص الدراسه و IRB

- Data Sheet

وتفضلوا بقبول الطلبة ولكم فائق الاحترام ،،

منسقة برنامج ماجستير تمريض التخدير

د. عالدة أبو السعود القيسي

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
دائرة التمريض والتوليد

نابلس - ص.ب 7 أو 707 هاتف 14;8;7;4;2342902 (09) (970) فاكسميل 2342910 (09) (970)
(Nablus- P.O.Box: 7 or 707- Tel (970) (09) 2342902;4;7;8;14- Faxmile (970) (09) 2342910
Email: nursing@najah.edu Web Site: www.najah.edu

جامعة النجاح الوطنية
كلية الدراسات العليا

مقارنة بين استخدام دواء ليدوكائين مع نتروجليسرين مقابل استخدام دواء ليدوكائين للمرضى الذين يخضعون للقسطرة القلبية من مسار الشريان الكعبري من حيث الألم ورضا المريض والآثار الجانبية

إعداد
محمد عرفات محمد قادوس

إشراف
د. إيمان شاويش
د. يونس عموري

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في تمريض التخدير،
من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس – فلسطين.

2024

مقارنة بين استخدام دواء ليدوكائين مع نتروجليسرين مقابل استخدام دواء ليدوكائين للمرضى الذين يخضعون للقسطرة القلبية من مسار الشريان الكعبري من حيث الألم ورضا المريض والآثار الجانبية

إعداد

محمد عرفات محمد قادوس

إشراف

د. إيمان شاويش

د. يونس عموري

الملخص

في الممار سة الـ سريرية ، تعد ق سطرة القلب عبر الكعبرة كنهج آمن ومريح للمريض. أجريت هذه الدرا سة للتحقيق ومقارنة آثار إ ضافة النتروجلي سرين إلى الليدوكائين مقارنة بالليدوكائين للمر ضى الذين يخ ضعون لقسطرة القلب من الطريق الكعبري.

اجريت هذه درا سة بتصميم ع شوائي مزدوج التعمية أحادي المركز بين المر ضى المقرر إجراء ق سطرة القلب لهم عبر الكعبرة. تم تعيين المرضـــى لتلقي إما التدخل (المجموعة أ) أو العلاج القياســـي (المجموعة ب ، الـ سيطرة). يتكون التدخل من 40 ملغ تحت الجلد من يدوكائين مع 200 ميكروغرام من النتروجليسرين و 200 ميكروغرام من النتروجلي سرين داخل الـ شرايين. يتكون العلاج القيا سي (التحكم) من 40 ملغ تحت الجلد من يدوكائين و 200 ميكروغرام من النتروجليسرين داخل الشرايين.

تم اختيار ما مجموعه 100 مريض ع شوائيا وتوزيعهم على مجموعتين: تم توزيع 50 مريضا على المجموعة أ و 50 مريضـــا على المجموعة ب. لم يكن مرضـــى الدراســـة في كلا المجموعتين مختلفين في المتغيرات الديموغرافية والـ سريرية والإجرائية (القيمة $P > 0.05$). في هذه الدرا سة ، ت سببت إ ضافة النتروجلي سرين في تقليل الـ شحوب والبرودة بـ شكل ملحوظ كمؤ شر على التـ سبب في نقص أقل في تروية اليد (القيمة $P < 0.05$). بالإضافة إلى ذلك ، أبلغ المرضى الذين تلقوا النتروجليسرين بالإضافة إلى الليدوكائين عن رضا أعلى ذي دلالة إحصائية مقارنة بالمرضى الذين تلقوا الليدوكائين (القيمة $P < 0.05$).

أظهرت نتائج هذه الدراسة أن إضافة النتروجليسرين إلى الليدوكائين قلل بشكل كبير من مؤشرات نقص تروية اليد كما يتضح من انخفاض الشحوب والبرودة. بالإضافة إلى ذلك ، فإن إضافة النتروجليسرين إلى يدوكائين زاد بشكل كبير من رضا المرضى. لم تكن هناك فروق أو زيادات ذات دلالة إحصائية في وقت الثقب ومدة التدخل. يمكن استخدام النتائج الواردة في هذه الدراسة من قبل أطباء القلب التداخلي وغيرهم من مقدمي الرعاية الصحية لتحسين توفير رعاية قسطرة القلب عبر الشعاعية عن طريق تقليل المضاعفات وتحسين سلامة المرضى وتعافيهم.

الكلمات المفتاحية: قسطرة القلب عبر الشريان الكعبري؛ ليدوكائين؛ نتروجليسرين؛ التدخل القلبي؛ تشنج الشريان الكعبري؛ إنسداد الشريان الكعبري؛ الألم؛ الرضا.