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Radial Hemostatic Compression Device Expedited Removal after Cardiac Catheterization

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N670 Internship: Quality Improvement and Outcomes Management
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July 31, 2022
Abstract

**Problem:** An increase in elective left heart catheterizations (LHC) using a trans-radial approach procedure for both outpatients and inpatients contributes to a delayed and sometimes postponement due to limited recovery beds available in the adult Cath lab recovery room.

**Context:** A thorough microsystem assessment in an Adult Cath lab department shows how current practice affects the unit performance in terms of productivity and the lack of information about the recent evidence-based studies related to radial hemostasis compression devices (HCD) expedited removal to shorten the patient length of stay and facilitate early discharge.

**Intervention:** The hemostatic radial compression device is weaned after one hour from its application until the radial HCD is removed after 30 minutes from the start of its weaning process. All patients who underwent LHC using radial artery access are observed for complications within two hours of recovery.

**Measures:** The outcome measure is to expedite the removal of radial HCD and to discharge 80% of the patient within two hours of recovery. The process measure is to discharge 80% of the elective patient cardiac catheterization using radial access within two hours of recovery. The balancing measure is to prevent patient readmission rates due to complications.

**Results:** After a thorough staff education and training, 100% of the patients who underwent elective LHC procedures using radial access successfully expedited the removal of HCD within two hours of recovery and were discharged safely in two hours or less from May 2022 to June 2022.

**Conclusions:** Trans radial access is the preferred and convenient way to perform LHC. Radial HCD expedited removal in less than two hours of recovery is proven safe and effective with fewer complications that can facilitate early discharges and increase unit productivity.
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Introduction

Trans radial access is the most favored approach in performing cardiac catheterization by accessing the radial artery in the past decades. Dr. Lucian Campeau first reported it in 1989 (Shah, et al., 2019). The reasons behind the trans-radial access popularity are reduced bleeding risk, reduced hematoma formation, early discharge, patient preference, low cost, and lower risk of morbidity and mortality rates (Anjum et al., 2017). Bleeding is one of the complications of trans-radial cardiac catheterization. Recent studies show much lower rates of bleeding complications with the trans-radial approach than with the femoral approach (Anjum et al., 2017). One of the key factors in lowering the bleeding rates with the trans-radial approach is using a hemostatic compression device (HCD) applied post-procedure. The shorter application of HCD reduces radial artery occlusion (RAO), reduced hospital length of stay, and enhances patient comfort and satisfaction (Lavi et al., 2017; Shah et al. 2018; Tuttle et al., 2019).

This paper will use the current evidence to discuss the efficacy of radial HCD expedited removal after a left heart catheterization (LHC). It will also discuss the effectiveness of decreasing the patient's length of stay, improving operational efficiency, and enhancing the financial strength of the department by expediting the removal of radial HCD after LHC.

Problem Description

The Adult Cath lab and Electrophysiology (EP) Holding room has a capacity of seven recovery beds to prepare and recover patients for Cath lab and EP procedures. These exclude inpatients that need to be ready before the procedure. Recently, there has been an increase in the number of elective procedures held in the Cath lab for both outpatients and inpatients. Most
elective procedures are delayed and sometimes postponed due to limited availability of recovery beds.

The current unit practice maintains the HCD for a minimum of two hours before the patient can safely discharge home. Recovering patients post LHC using a trans-radial approach for more than two hours is a considerable factor contributing to the department's problem. Due to the utilization of recovery beds to recover patients for more than 2 hours, the next patient had to wait until the previous patient was discharged. Some of the patients waiting for the procedure need to be rescheduled to the next available appointment, which will take weeks or even months. The rescheduled patient could have benefited from a LHC procedure to diagnose a potential heart blockage and prevent a heart attack.

Immediate diagnosis and treatment of heart blockages can prevent a potential heart attack. In the department, most elective patients experiencing cardiac symptoms must wait until the recovery bed is available, which delays their procedure. There is also an increase in staff overtime and burnout due to longer patient recovery. Numerous current evidence-based research studies show the effectiveness of expedited removal of HCD in less than two hours (Lavi et al., 2017; Shah et al., 2018; Tuttle et al., 2019). With the help of these research studies, the unit can revise its protocol in radial HCD removal, improve patient waiting time, accommodate all scheduled cases on time, and decrease staff burnout.

**Available Knowledge**

**PICOT Question**

In post-cardiac catheterization patients who had trans-radial access (P), how does the application of a radial compression device for 1 hour (I) compared to 2 hours of application (C) prevent bleeding and hematoma (O) within 2 hours of recovery post-procedure (T)?
Search Strategy

A thorough electronic search was conducted in January and March 2022. Using the USF library online services, five databases were accessed for article reviews: PubMed, CINAHL, Cochrane Library, Guidelines Clearinghouse, and Evidence-Based Journals. The search strategy focused on trans radial cardiac catheterization, post-cardiac catheterization complications via trans radial approach, and a hemostatic compression device benefits to prevent bleeding and hematoma. Search terms and topics used are cardiac catheterizations, compression devices, bleeding, hematoma, and trans radial. Hundreds of related articles were found from 2017 to 2022; most of them include randomized control trials. There were five articles chosen for review and evaluation as shown in the Appendix A. The criteria for selecting these research articles are solid scientific evidence of literature supporting their study and providing an adequate sample size for studies design.

Synthesis of Literature

A single-center prospective randomized control trial for patients who underwent diagnostic cardiac catheterization using radial access was done by Deuling et al. (2017). Patients were randomly assigned into two groups. An accelerated group in which the deflation of air from the HCD started after 1 hour from the hemostasis time. A standard care group in which the deflation began after 2 hours from the application of the HCD. One hundred seventy-three patients who underwent diagnostic cardiac catheterization using radial access were studied. The study concludes that there are no signs of localized bleeding in accelerated pressure reduction of HCD after cardiac catheterization. It increases patient comfort and shortened hospital stay.

The strength of the study is it improves the result of the previous research by using a 6F sheath that is commonly used for radial LHC procedure that is safe in deflating the radial HCD
in an hour compared to 2 hours deflation start post-procedure. The limitations of the study are the population was limited to patients who underwent diagnostic LHC using 6F sheath, and it is a single-center study that might not apply to other institutions due to different policies, procedures, and the different devices that are being used. The level and quality rating on the John Hopkins Nursing Evidence-Based Practice (JHNEBP) Tool was a Level 1A.

Lavi et al. (2017) conducted a randomized control trial for patients who underwent diagnostic cardiac catheterization via trans radial approach. Patients were randomly designated to either 20 minutes for ultrashort and 60 minutes for short application of HCD without any observed bleeding on the insertion site. HCD pressure was released cautiously for more than 20 minutes. A total of 568 patients underwent trans arterial cardiac catheterization with or without intervention. This study concludes that shorter application of radial compression device of at least 1 hour after cardiac catheterization is safe and associated with low incidence rate of radial artery occlusion.

The strength of this study is it improves the results of the previous research by having a substantial and randomized and by using more expeditious clamp release in both groups. The limitations are physician and patients were not blinded to randomization and no intervention was performed once RAO detected that may affect the occurrence of RAO after a week. This study was analyzed and rated using the JHNEBP Tool with a Level IA.

Riyami et al. (2020) conducted a single-center randomized control trial to compare two protocols, early deflation with increased interval and late deflation with smaller interval. The researchers compared these protocols with HCD in terms of the length of time to band removal. Protocol 1 is where air removal starts one hour after sheath removal, while Protocol 2 involves the removal of air after two hours of sheath removal. A total of 174 patients who underwent a
left heart catheterization was studied. This study concludes that trans-radial band deflation one hour after cardiac catheterization shows no significant bleeding, less discomfort for the patient, and quicker recovery and home discharges.

The strength of this study includes the removal of radial HCD after one hour after the sheath was removed with no complications such as bleeding and hematoma with no difference compared to two hours of radial HCD removal. The limitations of this study are inaccuracies in documenting the actual deflation time and multiple staff taking care of the patient, which causes inconsistency in patient care and audits. Also, researchers did no follow-up study for both protocols regarding their long-term effects on rates of radial artery occlusion. This study was rated with a Level IB using the JHNEBP Tool.

Shah et al. (2019) published a randomized, prospective, single center study who underwent cardiac catheterization via radial approach. This study is divided into two groups, an Accelerated Protocol (Group A), where the weaning was commenced 20 minutes after the sheath was pulled out, and an Adjusted Protocol or (Group B), in which weaning is based on the dose of antiplatelet or anti-coagulation used in the procedure. Radial artery ultrasound was used on all patients to show arterial patency. A total of 129 patients who underwent cardiac catheterization using the trans-radial approach was studied. Accelerated Protocol and Adjusted Protocol was used to measure the effectiveness of optimal weaning strategy of the trans radial band (TR band). Overall, there was no statistical difference in both groups. The radial compression device application was remarkably shorter in group A in contrast to Group B.

The strength of this study was supported by other studies that show effective weaning strategies for TR band to minimize complication for trans radial approach and this study evaluates all patients post TR band removal for radial artery patency. The study limitations
include a small sample size, single-center experience, lack of measurements for discharge time, and relationship to length of stay post-procedure. This study was rated with a Level IB using the JHNEBP Tool.

Tuttle et al. (2018) conducted a prospective cohort study of patients who underwent radial cardiac catheterization with or without percutaneous coronary intervention at a tertiary care training medical center. TR Band®, one of the hemostatic compression devices, was applied to the patient, which was detached after a prespecified amount of time set in each of three sequential groups: 2-h (120 minutes), 1-h (60 minutes), or 0.5-h (30 minutes). There were 354 patients with the same number in each cohort who participated in the study. The researchers found that it is safe to remove the air from the radial HCD at 0.5 h with no significant or number of complications. The data confirmed shorter hospital stay for the patient who underwent cardiac catheterization with or without intervention using the radial approach.

The strengths of this study included patients who underwent percutaneous coronary intervention (PCI) and make use of current patent hemostasis strategy, reduced hospital stay, improves patient satisfaction, and lowers healthcare cost by making the unit more efficient. The limitation in this study is due to the small sample size in each of the three groups, the study was underpowered to detect small changes in event rates. This study was rated with a Level IA using the JHNEBP Tool.

Rationale

Change is a vital component of nursing practice. Leading change is a challenge for nurse leaders amid the complexities and challenges of evolving health care environments in providing quality patient care (Wagner, 2018). Rogers Diffusion of Innovation theory is an integral theory that can serve the administrators, nursing informatics experts, information technologists, and
change agents in adopting new interventions and protocols in clinical settings. This theory will
guide the quality improvement project on how each team members will adopt and implement
new knowledge in expediting radial HCD in providing patient care. The idea also benefits the
targets of change since respect and consideration for all involved stakeholders are intertwined
with robust strategies for implementing innovative change (Kaminski, 2011). Rogers five stages
of adoption processes as shown in Appendix B are Knowledge or Awareness Stage (1),
Persuasion or Interest stage (2), Decision or Evaluation Stage (3), Implementation or Trial Stage
(4), and confirmation or Adoption Stage (5).

The Knowledge or Awareness is the first stage of Rogers theory. In this stage, the
innovation is exposed to individual but lacks of idea about the innovation. The second stage is
the Persuasion or Interest Stage. In this stage, the individual is intrigued about the innovation and
actively searching for information and details about the innovation. The third stage is the
Decision or Evaluation stage. In this stage, the individual considers change and contemplates the
pros and cons of implementing innovation. The fourth stage is the Implementation or Trial stage.
In this stage, the individual implements the innovation and acclimate the innovation to the
situation. During this stage, the individual also concludes the importance of the innovation and
may search for more information about it. The fifth and last stage is the Confirmation or
Adoption stage. In this stage, the individual confirms the decision to proceed using the
innovation.

Specific Project Aim

This project aims to expedite the removal of radial hemostatic compression device in less
than two hours to increase patient volume and shorten the length of patient recovery after a left
heart catheterization. Also, this project aims to discharge 80% of the patient who underwent LHC using radial access without any signs of complications by the end of July 2022.

**Context**

**Microsystem Assessment**

A clinical microsystem is the place where patients, families, care teams and information come together. It is imperative to the nurse leader to do periodic assessment of the microsystem to develop the current understanding of how the unit is functioning and to verify if the microsystem still meeting its intended goals. Refer to Appendix C for the Microsystem Assessment Tool.

**Purpose**

Adult cardiac catheterization and electrophysiology laboratory is a specialized unit where the physician performs minimally invasive cardiac catheterization procedure to diagnose and treat cardiovascular diseases in an academic medical center located in the Bay area. The unit's purpose is to provide care for patients with complex cardiac needs undergoing cardiac catheterization and electrophysiology (EP) procedures (UCSF Health Department of Nursing, n.d.). The mission of this unit is aligned with the world renowned academic medical center in the bay area, "The reason we exist- is Caring, Healing, Teaching, and Discovering" (UCSF Health, n.d.).

**Patients**

The unit offers services to adult cardiac patients ages 14 years old and above. Most patients are diagnosed with conditions such as coronary artery disease (CAD), shortness of breath (SOB), atrial fibrillation (AF), heart block, aortic stenosis, mitral regurgitation, heart failure (HF), and pulmonary hypertension. The highest number of cases performed are left heart
catheterization, right heart catheterization, percutaneous coronary intervention, electrophysiology studies with ablation, and pacemaker implants. Majority of elective procedure comes from the admissions office. Acute Myocardial Infarction (M.I) is usually admitted from the Emergency department (ED). Transfer from other hospitals generally gets admitted from the admissions office unless it is urgent. The majority of the patients undergoing cardiac catheterization prefer radial access compared to femoral access because of shorter recovery and comfort post-procedure. However, many patients experience pain in the access site during recovery because of the hemostatic compression device (HCD) applied to their wrist for up to two hours. Many patients who underwent cardiac catheterization want to discharge home as early as possible and go back to their normal activities sooner after the procedure without thinking about complications.

**Professionals**

There are two interventional cardiology fellows and three electrophysiology fellows assigned in the unit. The holding room has four Registered nurses (RN) in the morning and three RNs for the late shift. There are three RNs and a Radiology technician (RT) assigned in each procedure room. Most of the nurses working in the department hold a bachelor's and master's degree and have several years of experience in specialty areas. An on-call team with three RNs and one technician are available after hours and weekends if needed for urgent procedures. Nurses work closely with the multidisciplinary team to give outstanding patient and family-focused care and ensure exceptional patient outcomes (UCSF Department of Nursing, n.d.).

**Process**

The cardiology and electrophysiology fellows are responsible for consenting the patient to the procedure. The department has six procedure rooms and seven holding room beds. All
elective patients are being admitted, prepared, and recovered by the holding room RN. The procedure RN scrub, circulate and monitor the hemodynamics of the patient during the procedure. “Time out” is to be initiated by the attending physician before the start of the case. The average procedure time is about two hours. After the procedure, the patient is transferred to the holding room to recover for at least two hours before discharge. ISBAR is the tool that is being used in between hand-offs to a different unit.

Patterns

According to the American Heart Association (AHA) heart attack registry, the unit met local and national standards. Ninety percent of the patients with heart attacks admitted to the department meet the criteria of opening up the heart blockages within 30 minutes of arrival from ED (AHA, 2020). However, the unit oversee some metrics that affect caring for our patient population, including their families, such as post-op complications, patient waiting time, and discharge education, resulting in poor quality care outcomes and negative patient experience. The department has daily huddles to discuss specific issues such as staffing, patient flow, and patient safety. The leadership in this unit is open to any comments and suggestions to improve patient care and staff satisfaction.

IHI Culture Assessment

The department is grounded in its core values of compassion, respect, and the ethical responsibility for the patient and families to always tell the truth. The unit leadership expects ongoing communication, honesty, and transparency for all the tasks and opportunities that may arise, and it is closely monitored. Feedback is given by emails and team huddles. The department sees errors as a system failure, not by people. Policies, guidelines, and procedures for patients, families, and staff support a fair and just culture. The unit provides continuing support for
patients and families and is committed to delivering follow-up after the patient's discharge. Staff and families experiencing unanticipated outcomes or needing assistance in rendering care are provided with available resources to ensure everybody is supported and assisted as needed.

**SWOT Analysis**

SWOT analysis (See Appendix D) was conducted to determine the unit's strengths, weaknesses, opportunities, and threats for implementing practice and policy change. Some of the most compelling opportunities in implementing this new technique are it decreases patient late of stay and early discharge and decreases cost. Additionally, there is no extra cost to implement this technique as all necessary equipment is already being used in the department. Staff training and education can be done during huddles or downtime in the recovery room, creating no additional cost. However, two of the greatest threats in implementing the new technique are the staff resistance to change and the potential of complications such as bleeding and hematoma for nurses at the bedside that cannot be monitored at all times. Despite these threats, the strength and opportunities outweigh the risk and threats with significant benefits for the department's efficiency and financial stability.

**Return of Investments**

Implementing a new technique will include the cost of the procedure, recovery room utilization, and staffing needed for expediting the removal of the radial compression device. The department has no significant purchases since this project includes the current staffing such as physicians and nurses and other resources available in the unit. The total cost for this project for the first year is $8,000 per case. This amount includes the price for the LHC procedure estimated at $6,000, including supplies like catheters, contrast, radar band, Cath pack set and medications, and equipment. The labor cost for nurses and physicians who assisted the procedure is also
included in the amount. The recovery room utilization estimated at $2,000 per case consists of the supplies needed such as gauze, transparent dressing, elastic bandage, arm sling, recovery fees, and labor costs for nurses is included in the amount. Appendix E shows the projected budget estimates for the 1st and 2nd-year expenses.

The intended purpose of this project is to expedite the removal of a radial hemostatic compression device to discharge the patient early after the LHC procedure to accommodate more patients to help increase and strengthens the departments financial crisis due to procedure cancellations, staff overtime, non-productive hours, and high staff turnovers. This project aims to add at least two more elective patients who need an LHC procedure to increase and strengthen the financial crisis of the department. By adding at least 5 patients per month, the department will generate an estimated benefit of about $264,000 per month or $3,168,000 per year. A significant increase of $480,000 net benefit from the estimated department's annual cost in the previous year.

Appendix F illustrates the break-even analysis with a profit target of $4,500,000 for FY 2021 and FY 2022. In order to break even, the department must generate 396 procedures over the year and obtain a revenue of $9,504,000 to cover the $3,633,600 in total cost plus the $5,870,400 profit target. This profit target is close to a 6% profit margin. So that every $1 dollar the department generates for LHC procedure, approximately $0.06 profit is generated.

**Communication Plan**

One of the barriers that affect the efficiency and workflow in our department is the lack of information about the current evidence-based studies related to radial hemostasis compression devices expedited removal to shorten the patient length of stay and facilitate early discharge. TeamSTEPPS is an evidence-based toolkit that promotes collaboration and teamwork in
healthcare delivery teams to improve the quality of care and safety (Matzkie et al., 2021).

Communication and leadership are the two TeamSTEPPS core principles that enhance team competency outcomes, including knowledge sharing, attitudes of mutual trust, orientation of the team, and performance of accuracy, adaptability, efficiency, productivity, and safety (Matzkie et al., 2021).

TeamSTEPPS uses several techniques to enhance communication among team members in high-stress situations requiring immediate attention and action, including call-outs and check-backs technique. Call-out is a strategy of repeating information to the leader, communicating vital information, and assigning responsibility to a specific team member. Check-back is a communication strategy where the leader sends a message to their member, and the member receives the message and provides feedback. The leader double-checks to make sure the member received the correct message. See Appendix G for the closed loop communication model.

TeamSTEPPS also defines effective team leaders as those who can manage and organize the team, articulate and identify clearly defined goals, appropriately assign tasks and responsibilities to team members, allocate resources, facilitate conflict resolution, and model effective teamwork (Matzkie et al., 2021).

**Intervention**

Adult patients scheduled for elective cardiac catheterization using radial access are the population that will benefit from this quality improvement project. The current unit practice is to maintain the HCD for a minimum of two hours before the patient can be safely discharged home. However, unit cases have increased in recent years, and fewer recovery beds are available for patient observation. There is also an increase in staff overtime and burnout due to longer patient recovery time. Numerous current evidence-based research studies show the effectiveness of
expedited removal of HCD in less than two hours (Lavi et al., 2017; Shah et al., 2019; Tuttle et al., 2019).

The hemostatic radial compression device is weaned by turning the dial counterclockwise by three notches after one hour from its application, then turning the dial counterclockwise by three notches every 5 minutes until the strap is loose around the wrist and removed after 30 minutes from the start of its weaning process. All patients who underwent a cardiac catheterization using radial artery access are observed for any sign of bleeding and hematoma and discharged safely within two hours of recovery. Revising the current policies for radial compression devices using the recent evidence will help decompress the number of patients in the recovery room and make more rooms for patients who need this procedure to prevent future adverse events such as heart attack and even death. It also enhances the nurse’s clinical expertise and personal knowledge of how safe and effective the expedited removal of HCD prevents bleeding and lowers radial artery occlusion risk. Also, it eliminates nurse burnout due to physical and emotional exhaustion that may lead to unsafe nursing practice because of a much shorter recovery time. Refer to Appendix H for the driver’s diagram and change to test illustration.

**Study of the Intervention**

Data will be collected from the Radar band audit sheet (Refer to Appendix I) and the patient's electronic medical record pre-intervention for at least two months to establish a baseline. Data collection will be done in two stages, the pre-intervention stage, in which the current standard timeframe of two hours before weaning the band was audited, and the time patient is discharged home from March through April 2022. The post-intervention stage will commence after the staff education and training are completed. The new technique in expediting the radial HCD of one hour before weaning the band was audited, and the time patient was
discharged from May through June 2022. Monthly audits were made to obtain data and compare pre- and post-intervention radial HCD removal and discharge times. Data obtained will be re-evaluated every week based on the result. See Appendix J for the project timelines. Suppose complications such as bleeding and hematoma happen within two hours of recovery after educating and training the staff, and a new technique has been standardized and implemented. In that case, the team must repeat the PDSA cycle to find better methods to improve the new technique.

**Measures**

Measurement is a vital part of testing and implementing changes. It tells the team whether their changes lead to improvement (IHI, n.d.). The outcome measure is to expedite the removal of radial HCD in less than two hours after cardiac catheterization and to discharge 80% of the patient within two hours of recovery. The process measure is to discharge 80% of the elective patient safely without any signs of complications such as bleeding or hematoma after cardiac catheterization using radial access within two hours of recovery. The balancing measure is to prevent patient readmission rates due to complications such as bleeding and hematoma after the patient is discharged home. This quality improvement project's specific aim in changing the technique for recovering patients after radial cardiac catheterization is to increase patient volume and shorten the length of patient recovery after a LHC. Also, this project aims to discharge 80% of the patient within two hours of recovery who underwent LHC using radial access without any signs of complications by the end of July 2022. Refer to Appendix K for measurements strategy.

**Ethical Considerations**

The absence of clear guidelines in a quality improvement project can lead to ethical considerations being disserted, ignored, or addressed desultory, potentially increasing harm or
destroying trust and accountability in healthcare settings (Hunt et al., 2021). Nurse leaders are responsible for assuring that the work environment is directed by ethical principles (King et al., 2019). This quality improvement project aligns with the Jesuit values for healthcare’s social justice. With the successful implementation of this project, many patients who need this procedure will benefit from timely diagnosis and interventions if needed and mitigating procedure delays and cancellations for patients that might need a LHC procedure to prevent heart attacks and emergency admissions. Also, this quality improvement project aligns with the American Nurses Association (ANA) Code of ethics Provision 7 that nurses should uplift their profession by utilizing available evidence through scholarly work in promoting health and providing quality care for every individual (ANA, 2015).

This quality improvement project to expedite the removal of radial HCD after cardiac catheterization has been reviewed by the supervising faculty of the University of San Francisco School of Nursing and Health Professions and verified to be a quality improvement project that does not require approval from the IRB (Appendix L). Patient confidentiality was ensured by not providing any personal information when collecting data from the electronic medical record or audit sheet about the patient. All elective patients who underwent an elective LHC procedure using radial access are treated equally as per unit standards of care. No funding was received or granted for this quality improvement project. The project leader declares no conflict of interest.

**Outcome Measure Results**

The outcome measure is to expedite the removal of radial HCD in less than two hours after cardiac catheterization and discharge the patient home within two hours of recovery. Monthly audits were made to obtain data and compare the pre-and post-intervention and the discharge time. Data collection was done in two stages, the pre-intervention standard timeframe
of two hours of weaning from March through April 2022 and post-intervention of one-hour weaning from May through June 2022. Pre- and post-intervention audits were compared using a line graph as shown in Appendix M and Appendix N respectively.

A total of seventy patients who underwent elective LHC using radial access was intervened for the month of May and June 2022. 100% of the patients post-intervention successfully expedited the removal of radial HCD within 2 hours or less without any complications such as bleeding and hematoma compared to March and April 2022 Pre interventions that took more than two hours for the radial HCD to be removed. 100% of patients who underwent elective LHC procedures were discharged home safely post-intervention without any complications.

Successful measurement is a cornerstone of successful improvement. Measurement allows quality improvement (QI) teams to demonstrate current or baseline performance, set goals for future performance, and monitor the effects of changes as they are made (IHI, n.d.). The project results are expected as numerous available evidence shows that releasing the radial HCD an hour from its application has no difference in bleeding and hematoma compared to two hours of its application (Lavi et al., 2017; Shah et al. 2018; Tuttle et al., 2019).

**Summary**

Overall, expediting the removal of radial HCD in less than two hours is safe and effective. The support of the unit leadership plays an essential role in the success of this quality improvement project. Staff education and training on how to expedite the radial HCD utilizing the available evidence contribute a significant impact to the successful change. After implementing holding room education and training, the staff explained and verbalized the importance and benefits of expedited removal of radial HCD after cardiac catheterization.
Second, the holding room nurses demonstrated safely and effectively how to release the radial HCD independently in less than two hours from the hemostasis time. Lastly, holding room nurses identify signs of complications immediately to decrease the incidence of bleeding and hematoma formation during recovery before discharging the patient home.

**Conclusion**

Trans radial access is the preferred and most convenient way to perform coronary angiogram with or without intervention for physicians and patients. The new technique in expediting the removal of radial HCD should be incorporated with the unit competencies checklists for the staff and new hires and monitored monthly with the project leader to sustain the project. The project leader should monitor for any barriers in expediting the removal of radial HCD such as complications, transportation, and patient mobility status and consider any alternative and available resources to prevent those barriers. The availability and application of the current evidence-based practice research in expediting the removal of radial HCD in facilitating early discharge will guide other departments to enhance efficiency while providing quality care.

Radial HCD expedited removal in less than two hours of recovery is proven safe and effective with fewer complications that reduce mortality and morbidity rates. It also shortens recovery time, lowers the cost of hospital expenses, and provides patient satisfaction. There are several implications of these studies for nursing practice. It enhances the nurse's clinical expertise and knowledge of how safe and effective the expedited removal of HCD prevents bleeding and lowers radial artery occlusion risk. It highlights the nurse leader's role in improving a healthy work environment by implementing changes to provide quality nursing care. A healthy work environment motivates and empowers nurses to do their profession safely and effectively.
Furthermore, it eliminates nurse burnout due to physical and emotional exhaustion that may lead to unsafe nursing practice.
References


## Appendices

### Appendix A- Evaluation Table

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Sample</th>
<th>Outcome/Feasibility</th>
<th>Evidence Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>An accelerated pressure weaning of the radial compression device after 1 hour of application shows no signs of bleeding, increases comfort for the patient and shortened the time to hospital discharge. Useful in developing and implementing new protocol for radial hemostatic compression device expedited removal safely and efficiently.</td>
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<td></td>
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<td>Shorter application of radial compression device of at least 1 hour after cardiac catheterization is safe and associated with low incidence rate of radial artery occlusion. Useful in developing a new protocol in expediting the removal of the radial hemostatic compression device for at least an hour.</td>
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<tr>
<td>Reference</td>
<td>Study Design</td>
<td>Participants</td>
<td>Primary Outcome</td>
<td>Summary</td>
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<tr>
<td>Riyadh, H. A., Riyami, A. A., &amp; Nadar, S. K. (2020).</td>
<td>Randomized Control Trial</td>
<td>174 patients from a single center medical institution in the middle east.</td>
<td>Trans radial band deflation 1 hour after cardiac catheterization shows no significant bleeding, less discomfort for the patient and quicker recovery and home discharges.</td>
<td>I B</td>
</tr>
<tr>
<td>Shah, S., Gindi, R., Basir, M., Khandelwal, A., Alqarqaz, M., Zaidan, M., Voeltz, M., Koenig, G., Kim, H., O’Neill, W., &amp; Alaswad, K. (2019).</td>
<td>Prospective Randomized Control Trial</td>
<td>129 patients in a single center medical institution</td>
<td>Accelerated protocol (Group A) weaning starts in 20 mins. 2 mL of air removed regardless of blood thinners given during the procedure. Adjusted protocol (Group B) weaning starts 30 mins for diagnostic procedure, PCI with heparin or Bivalirudin starts at 60 mins. Overall, there was no statistical difference in both groups. The radial compression device application was remarkably shorter in group A in contrast to Group B.</td>
<td>I B</td>
</tr>
<tr>
<td>Tuttle, M., Haroian, N., Gavin, L., Esposito, C., &amp; Ho, K. (2019).</td>
<td>Prospective Cohort Study</td>
<td>354 patients from tertiary care academic medical center</td>
<td>The researchers found that it is safe to remove the air from the radial HCD at 0.5 h with no significant or number of complications. They also found out a shorter hospital stay for the patient who underwent cardiac catheterization with or without intervention using the radial approach.</td>
<td>I A</td>
</tr>
</tbody>
</table>
Appendix B

Roger’s Five Stages of Adoption Process

PRIOR CONDITIONS
1. Previous practice
2. Felt needs/problems
3. Innovativeness
4. Norms of the social systems

COMMUNICATION CHANNELS

I. KNOWLEDGE
   Characteristics of the Decision-Making Unit
   1. Socioeconomic characteristics
   2. Personality variables
   3. Communication behavior

II. PERSUASION
   Perceived Characteristics of the Innovation
   1. Relative advantage
   2. Compatibility
   3. Complexity
   4. Trialability
   5. Observability

III. DECISION

IV. IMPLEMENTATION
   1. Adoption
   2. Rejection

V. CONFIRMATION
   Continued Adoption
   Continued Rejection
   Discontinuance
   Later Adoption
Appendix C

Microsystem Assessment Tool

Inpatient Unit Profile

A. Purpose: Why does your unit exist? The purpose of this unit is to care for cardiac cath and Electrophysiology (EP) patients that provide minimally invasive cardioiology and EP procedures for patients with complex cardiac needs.

Administrative Director: Matthew Bogerman  
Nurse Director: Lisa Konstanind 
Medical Director: Dr. Thomas Ports

B. Know Your Patients: Take a close look into your unit, create a “high-level” picture of the PATIENT POPULATION that you serve. Who are they? What resources do they use? How do the patients view the care they receive?

Est. Age Distribution of Pts.: %
- 19-50 years: 30
- 51-65 years: 25
- 66-75 years: 30
- 76+ years: 15

% Females: 50

Living Situation: %
- Married: 50
- Domestic Partner: 5
- Live Alone: 30
- Live with Others: 5

Skilled Nursing Facility: 5
- Nursing Home: 2
- Home: 25

Patient Type | LOS avg. | Range
- Medical: 5-14
- Surgical: 1-4

Mortality Rate: No

List Your Top 10 Diagnoses/Conditions
- 1.CAD
- 2.Asthma
- 3.Diabetes
- 4.Atrial Fibrillation
- 5.Heart Block
- 6.Sick Sinus syn.
- 7.Aortic Stenosis
- 9.Pain

Patient Satisfaction Scores
- % Always
- Nurses: 95.9
- Doctors: 94.8
- Environment: 93.3
- Pain: 95.7
- Discharge: % Yes

Overall: % Excellent

Pt Population Census: Do these numbers change by season? (Y/N)
- Pt Census by Hour: Y
- Pt Census by Day: Y
- Pt Census by Week: Y
- Pt Census by Year: Y

30 Day Readmit Rate: Y

Frequency of Inability to Admit: %

“Complete ‘Through the Eyes of Your Patient’, pg 8

C. Know Your Professionals: Use the following template to create a comprehensive picture of your unit. Who does what and where? Is the right person doing the right activity? Are roles being optimized? Are all roles who contribute to the patient experience listed?

Current Staff
- MD Total: 5
- Hospitalists Total: N/A
- Unit Leader Total: 5
- RNs Total: 23
- LPNs Total: N/A
- NAs Total: N/A
- Technicians Total: 3
- Secretaries Total: 3
- Clinical Resource Coord.: N/A
- Social Worker: N/A
- Health Service Asst.: N/A
- Ancillary Staff: 3

Do you use Per Diems? X Yes NO
Do you use Travelers? X Yes NO
Do you use On Call Staff? X Yes NO
Do you use a Float Pool? X Yes NO

Staff Satisfaction Scores
- % Always
- Internal Medicine: 90
- Hematology/Oncology: 90
- Pulmonary: 90
- Family Practice: 90
- ICU: 90
- Other Cardiology: 90

Supporting Diagnostic Departments
- Laboratory, Echocardiography lab, Blood Bank, Vascular lab, Anesthesia

Admitting Medical Service: %


1. Create flow charts of routine processes.


2. Complete the Core and Supporting Process Assessment Tool, pg 14

E. Know Your Patients: What patterns are present but not acknowledged in your microsystem? What is the leadership and social pattern?

- Does every member of the unit meet regularly as a team? Yes (huddles)
- How frequently? Daily M-F 0700-0715
- Do you use any of the following? Check all that apply
- Standing Orders/Critical Pathways
- Rapid Response Team
- Bed Management Rounds
- Multidisciplinary Family Rounds
- Midnight Rounds
- Prevention/Change Role
- Discharge Goals

- What is the most significant pattern of variation?

*Complete “Metrics that Matter”, pg 20 & 21
Appendix D

SWOT Analysis

**STRENGTHS (+)**
- No extra cost for staff training.
- All equipment is already being used in the holding room.
- All RN's in the unit are specialized in recovering patients post LHC.
- Standardization of the technique for radial HCD removal.

**WEAKNESSES (−)**
- All staff must be trained to the new technique.
- Difficult to monitor staff in implementing the new technique.
- Inconsistencies with the timing of the radial HCD removal.

**OPPORTUNITIES (+)**
- Provide comfort for the patient.
- Early discharges post-procedure.
- Decrease cost of the unit.
- Increase the efficiency of the lab.

**THREATS (−)**
- Staff resistance to change.
- Potential for complication such as bleeding and hematoma.
- Nurses at the bedside cannot be monitored the patient at all times.
Appendix E

Estimated Cost for the Procedure and Labor for the First and Second Years

<table>
<thead>
<tr>
<th>Facility Expenses</th>
<th>First Year Cost</th>
<th>Second Year Cost</th>
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<tbody>
<tr>
<td><strong>LHC Procedure Cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Includes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Labor Cost for 3 RN x 2hrs/case and MD per case - $1,300</td>
<td>$6,000/case</td>
<td>N/a</td>
</tr>
<tr>
<td>• Supplies - $3,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Medication - $700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cathlab equipment use - $1,000</td>
<td>$6,000/case</td>
<td>N/a</td>
</tr>
<tr>
<td><strong>Recovery Room Utilization</strong></td>
<td>$2,000/ per case</td>
<td>N/a</td>
</tr>
<tr>
<td>Includes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Labor cost for 2 RN x 2 hrs/recovery - $300</td>
<td>$2,000/ per case</td>
<td>N/a</td>
</tr>
<tr>
<td>• Supplies: $500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Holding room equipment use - $1,200</td>
<td>$2,000/ per case</td>
<td>N/a</td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td><strong>$8,000/ patient</strong></td>
<td><strong>N/a</strong></td>
</tr>
</tbody>
</table>

Note: The total expenses are the current estimated amount cost to the department for the services provided.
Appendix F

Break-Even Analysis with a profit target in FY 2021 and FY 2022.

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Units of service or Volume (UOS)</th>
<th>Total Fixed Cost (TFC)</th>
<th>Fixed Cost per Unit (FCU)</th>
<th>Total Variable Cost (TVC)</th>
<th>Variable Cost per Unit (VCU)</th>
<th>Total Cost (TC)</th>
<th>Total Cost per Unit (TCU)</th>
<th>Price (RU)</th>
<th>Profit Target (P)</th>
<th>Total Revenue (TR)</th>
<th>Break Even</th>
<th>Contribution Margin</th>
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<tr>
<td>FY 2021</td>
<td>336</td>
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<td>$8,900</td>
<td>$537,600</td>
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<td>$9,504,000</td>
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Appendix G

Closed Loop Communication Model

Sender initiates message

Sender verifies message was received

Receiver accepts message, provides feedback confirmation

COMMUNICATION

CLOSED

LOOP
Appendix H

Drivers Diagram and Change to Test

Aim

To expedite the removal of radial hemostasis compression device to facilitate early discharge for patients after a radial cardiac catheterization

Primary Drivers

- Disseminate the available scientific knowledge.
- Staff education and training.
- Standardization of radial HCD removal.

Secondary Drivers

- Review of related literature.
- Project presentation.
- Develop staff training for nurses.
- Standards of care post-cardiac catheterization.
- Complication management.

Change to Test

- Evaluate the existing practice and compare to the current evidence-based practice.
- Test the effectiveness of weaning the radial HCD at least an hour from the hemostasis time.
- Test the effectiveness of the removal of radial HCD in less than two hours from the hemostasis time.
- Improving workflow by decreasing patient length of recovery and discharging patients early.
Appendix I

Radial Compression Device Audit Sheet

Pre- Intervention

March 2022

<table>
<thead>
<tr>
<th>Date</th>
<th>NHIS</th>
<th>Assessment Time</th>
<th>Time Compression Device Removed</th>
<th>Total Time Compression Device Removed</th>
<th>Time Patient Discharge Out of Unit of Care</th>
<th>Total Amount of Flt Time from Intervention to Discharge</th>
<th>Research for Delay in Discharge</th>
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</thead>
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*Total of 28 patients

April 2022

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<th>Time Compression Device Removed</th>
<th>Total Time Compression Device Removed</th>
<th>Time Patient Discharge Out of Unit of Care</th>
<th>Total Amount of Flt Time from Intervention to Discharge</th>
<th>Research for Delay in Discharge</th>
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*Total of 28 Patients

Post- Intervention

May 2022

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*Total of 35 patients

June 2022

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<th>Total Time Compression Device Removed</th>
<th>Time Patient Discharge Out of Unit of Care</th>
<th>Total Amount of Flt Time from Intervention to Discharge</th>
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*Total of 35 Patients
Appendix J

Project Timeline

Action Plan for Initiating the New Radial Compression Device Technique

- Project Kick off: Meeting with the unit leaders
- Meeting with the staff nurses in the unit
- Identify unit champions and trainings
- Implementation of the new technique
- Monitoring and Documentation Measurements (every week)
- Technique Maintenance
Appendix K

Measurement Strategy

Background (Global Aim): To facilitate the effectiveness and safety of expedited removal of radial hemostatic compression devices to increase patient volume and shorten the length of patient recovery after cardiac catheterization in adult catheterization laboratory by July 2022.

Population Criteria: Adult patients scheduled for elective left heart catheterization via radial access and to be discharged the same day.

Data collection method: Data will be collected from the Radar band audit sheet and the patient’s electronic medical record pre-intervention for at least two months to establish a baseline. Data collection will be done in two stages, the pre-intervention stage, in which we audited the time for the standard timeframe of two hours of weaning, and the time patient is discharged home from March through April 2022. In the post-intervention stage, we audited the time for one-hour weaning and the time the patient was discharged home from May through June 2022. Monthly audits were made to obtain data and compare the pre-and post-intervention discharge times. Data obtained will be re-evaluated every week based on the result.

Data Definitions

<table>
<thead>
<tr>
<th>Data Element</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Hemostasis Time</td>
<td>The time the radial hemostasis compression device was applied.</td>
</tr>
<tr>
<td>Compression Device Removed</td>
<td>The time the radial hemostasis compression device was removed.</td>
</tr>
<tr>
<td>Patient discharge time</td>
<td>The time the patient left the unit.</td>
</tr>
<tr>
<td>Radar Band Audit Sheet</td>
<td>The tool used to audit data that has been collected.</td>
</tr>
</tbody>
</table>

Measure Description

<table>
<thead>
<tr>
<th>Measure</th>
<th>Measure Definition</th>
<th>Data Collection Source</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial hemostasis compression device expedited removal</td>
<td>Radial hemostasis compression device weaning starts after one hour from application and removal in less than two hours.</td>
<td>Radar Band Audit Sheet or EMR</td>
<td>80%</td>
</tr>
<tr>
<td>Discharging patient to home safely</td>
<td>Discharge patient to home without any complications such as bleeding and hematoma.</td>
<td>Radar Band Audit Sheet or EMR</td>
<td>80%</td>
</tr>
</tbody>
</table>
Appendix L

CNL Project: Statement of Non-Research Determination Form

Student Name: Patrick Perito Saludares

Title of Project: Radial Hemostatic Compression Device Expedited Removal after Cardiac Catheterization

Brief Description of Project:

A) Aim Statement: This project aims to evaluate the effectiveness and safety of expedited removal of radial hemostatic compression devices in less than two hours to increase patient volume and shorten the length of patient recovery after cardiac catheterization.

B) Description of Intervention: The hemostatic radial compression device is weaned by turning the dial counter-clockwise x3 after one hour from its application, then turning the dial counter-clockwise x3 every 5 minutes until the strap is loose around the wrist and removed after 30 minutes from the start of its weaning process. All patients who underwent a cardiac catheterization using radial artery access are observed for any sign of bleeding and hematoma and discharged safely within two hours of recovery.

C) How will this intervention change practice? This intervention will change how nurses in the department performs the removal of radial compression device to facilitate early discharges, increases volume and improve operational efficiency in the department.

D) Outcome measurements: Monthly audits were made to obtained data and compare the pre- and post-intervention and the discharge time. Data collection was done in two stages, the pre-intervention standard timeframe of two hours weaning from March through April 2022 and post-intervention of one-hour weaning from May through June 2022.
To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used: (http://answers.hhs.gov/ohrp/categories/1569)

☒ This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Student may proceed with implementation.

☐ This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments:

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>The aim of the project is to improve the process or delivery of care with established/accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.</td>
<td>X</td>
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<tr>
<td>The specific aim is to improve performance on a specific service or program and is a part of usual care. ALL participants will receive standard of care.</td>
<td>X</td>
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<tr>
<td>The project is NOT designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does NOT follow a protocol that overrides clinical decision-making.</td>
<td>X</td>
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<tr>
<td>The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does NOT develop paradigms or untested methods or new untested standards.</td>
<td>X</td>
<td></td>
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<tr>
<td>The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does NOT seek to test an intervention that is beyond current science and experience.</td>
<td>X</td>
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<tr>
<td>The project is conducted by staff who are working at an agency that has an agreement with USF SONHP.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project has NO funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., not a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: “This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board.”</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
ANSWER KEY: If the answer to ALL of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. IRB review is not required. Keep a copy of this checklist in your files. If the answer to ANY of these questions is NO, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME (Please print):

Patrick Perito Saludares

Signature of Student:

April 9, 2022

______________________________________________________DATE____________

SUPERVISING FACULTY MEMBER NAME (Please print):

Dr. Susan Mortell

Signature of Supervising Faculty Member

April 10, 2022

______________________________________________________DATE____________
Appendix M

Pre-Intervention Line Graph

March 2022 Pre-Intervention

April 2022 Pre-Intervention
Appendix N

Post-Intervention Line Graph

May 2022 Post-Intervention

June 2022 Post-Intervention