

Assessment of Acute Complications for Arrhythmic Patients Undergoing Cardiac Electrophysiology Study

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Abstract

Background: Acute complications in arrhythmic patients undergoing cardiac electrophysiology study (EPS) can have significant clinical implications. Assessing these complications is crucial for optimizing patient care. **Aim:** Assessment of acute complications for arrhythmic patients undergoing cardiac electrophysiology study. **Research design:** Descriptive research design was utilized. **Setting:** The study was conducted in cardiac catheterization unit at Assiut University Heart Hospital. **Sample:** sixty adult patients underwent EPS. **Tools, Tool (I):** Patient's assessment sheet, **Tool (II):** Patient's complications assessment sheet. **Results:** Out of the studied patients (60) who underwent EPS, three patients encountered major complications, two of them (2.3%) developed atrioventricular block, while one patient experienced deep venous thrombosis. Minor complications were experienced by 25.0% of the total studied patients. Heart disease (P value, 0.022), hypertension (P-value, 0.025), and smoking (P-value, 0.040), identified as significant predictor for EPS complications. **Conclusion:** Cardiac electrophysiology studies demonstrated a low incidence of complications, with hypertension, heart disease, and smoking identified as potential risk factors. Overall, EPS appears to be a safe procedure for diagnosing and treating cardiac arrhythmias. **Recommendation:** Nursing protocol must be implemented for nurses, who are integral in patient care, regarding the acute complications associated with cardiac electrophysiology studies for early recognition and management.

Keywords: Acute complication, Arrhythmia & Cardiac electrophysiology.

Introduction

Arrhythmias are conditions that can impact the generation, conduction, or both of electrical impulses traveling through the heart. Disruptions in heart rhythm, heart rate, or both may occur due to arrhythmias. Various types of arrhythmias exist, including sinus, atrial, junctional, and ventricular arrhythmias, each with its own subcategories. (Abozeid et al., 2023)

The worldwide incidence of arrhythmias, specifically atrial fibrillation (AF), has notably risen over the last thirty years and currently stands at approximately 60 million cases (Elliott, et al., 2023). Ventricular tachycardia (VT) represents a significant contributor to sudden cardiac death and is linked to a considerable escalation in both morbidity and mortality. (Kotake, et al., 2023).

Cardiac electrophysiology study (EPS) is a specialized field within cardiology that concentrates on diagnosing and treating patients with complex rhythm or conduction irregularities. This study is employed to evaluate the functionality of the Sinoatrial (SA) node, the atrioventricular (AV) node, and the His-Purkinje system. Additionally, it helps in identifying the characteristics of arrhythmia and

mapping the location of arrhythmia foci for potential ablation (Katritsis & Morady, 2021).

Indications for interventional electrophysiology and catheter ablation involve a two-stage process comprising both diagnostic EP and catheter ablation. The initial phase of the procedure focuses on confirming the mechanism of the arrhythmia, while the subsequent stage involves ablation. This procedure is indicated for conditions such as atrioventricular nodal reentrant tachycardia, atrioventricular reentrant tachycardia, atrial fibrillation or flutter, and ventricular tachycardia (Gillingham, 2018).

Patients undergoing EPS may encounter acute complications which includes minors and major complications. Major complications defined as those likely to result in permanent sequelae, requiring intervention to prevent permanent injury or death (Vasheghani et al., 2018). These major complications encompass death, cerebrovascular accidents (0.05% to 0.01%), though the risk of stroke is higher with curative atrial fibrillation ablation. Other major complications involve tamponade, vascular damage, deep venous thrombosis, and heart block necessitating a permanent pacemaker (0.5%), the likelihood of which depends on the proximity of

the ablation lesion to the atrioventricular node (Marry & Adrienne, 2019).

Minor complications are defined as a treatment-related adverse event requiring nominal therapy or no treatment with or without overnight hospitalization for observation (Padia et al., 2021). Including issues with vascular access such as hematoma, bleeding, mild-to-moderate pericardial effusion, and arteriovenous fistula (Marry & Adrienne, 2019).

Post-procedure nursing management resembles that of a patient after cardiac catheterization, with an emphasis on early detection and intervention for anticipated problem. The nurse must closely and continuously monitor the patient, taking prompt and appropriate action to mitigate the harmful effects of complications. Immediate postoperative care guidelines include restricting activity until hemostasis is achieved and providing care for the catheter insertion site to prevent complications such as bleeding (Reinisch, et al., 2019).

Significance of the study

Millions of individuals globally are affected by arrhythmias, which represent prevalent and clinically significant cardiovascular issues. Around 2.7 to 6.1 million individuals in the United States alone experience AF, and it is projected that by 2030, there will probably be 12.1 million cases worldwide (Chaudhary et al., 2023). According to the patients' records at Assiut University Hear Hospital, it has been found that there were about 120 arrhythmic cases undergoing cardiac electrophysiology study every year.

A novel diagnostic and treatment procedure for cardiac arrhythmia, known as cardiac electrophysiology study (EPS), has emerged. Electrophysiology (EPS) studies and radiofrequency catheter ablations (RFCAs) can lead to a variety of complications. (Vasheghani et al., 2018). The experiences of researchers in cardiac catheterization at Assiut University Heart Hospital indicate a tendency to neglect this aspect of care in nursing research and documentation and there is a shortage of international studies addressing EPS complications, and no national studies have been conducted on this topic. Effective nursing assessment and monitoring are crucial for developing an appropriate therapeutic approach to manage these complications.

Aims of the study:

The aim of this study was:

Assessment of acute complications for arrhythmic patients undergoing cardiac electrophysiology study.

Research question:

What are the acute complications experienced by arrhythmic Patients undergoing cardiac electrophysiology study?

Methods

Research design:

A descriptive research design was utilized to carry out this study. Is often used to describe and explore human behaviors. Descriptive research might use a variety of data collection methods with the most common being questionnaires and interviews. It was a useful approach in research that had clear benefits in helping to describe and explore variables and constructs of interest (Jain, 2021).

Setting:

The study conducted in cardiac catheterization unit at Assiut University Heart Hospital.

Sample:

All suggested patients undergoing cardiac electrophysiology studies at Assiut University Heart Hospital at catheterization unit over the duration of six months were included. There were 60 adult male and female patients during this time, with ages ranging from 18 to less than or equal to 65 years old.

Tools of data collection:

Tool (I): Patient's assessment sheet:

It was designed and developed by the researcher based on the relevant recent national and international literatures it is divided into two parts:

Part I: Patient's Demographic data: -

The purpose of this section was to assess the patient's demographic data, consisted of six items (age, gender, marital status, level of education and occupation, and to examine patient habits such as smoking.

Part II: clinical Data:

The purpose of this section was to evaluate the patient's clinical data, and consisted of (4) items as types of arrhythmia, comorbidities, length of stay and duration of cardiac electrophysiology study.

Tool II: Patient's complications assessment sheet:

This tool was designed and developed by the researcher based on the following literatures. (Yamada et al., 2022)

(Vyas & Murti., 2023), (Majeed & Sattar., 2022). amid to assess acute complications for arrhythmic patients underwent cardiac electrophysiology study. It included two parts:

Part I: Minor acute complications:

Assess minor acute complications in patients underwent cardiac electrophysiology study, including hematoma at the puncture site, bleeding, mild-to-moderate pericardial effusion, arteriovenous fistula, and vascular damage.

Part II: Major acute complications.

Assess major acute complications in patients underwent EPS, including cardiopulmonary arrest, death, tamponade, AV block, and cerebrovascular accident.

Procedures:

To accomplish the aim of the study, it passed through the following phases:

Preparatory phase:**Tools development:**

- Official permission was obtained to carry out the proposed study, enabling the researcher to initiate data collection.
- Tools for collecting data were developed based on reviewing the current, past, local, and international related literature in various aspects using books, articles, journals, magazines, and references.

Pilot study

The pilot study included 10% of the studied sample (6 patients) they were used to determine the tools' applicability and clarity as well to estimate time needed to fill in the data collection tools. The data from the pilot study were analyzed; no changes were made to the tools utilized, so the sample selected for the pilot study were involved in the study.

Content validity and Reliability

Face validity: was done by five specialists who evaluated the tools for clarity, relevance, comprehensiveness, and understanding, including three professors and one assistant professors from the critical care nursing team and one professor from the Cardiovascular Medicine. Minor modifications were made and the tools were then designed in their final version and reliability tests were conducted.

Reliability of the tool was measured by Cronbach's alpha coefficient (r-0.722).

Ethical considerations

Research proposal was approved from Ethical Committee in the Faculty of Nursing, Assiut University on (2023/11/27), with ID approval (1120240503). There was no risk for study subject during application of the study. Confidentiality and privacy of the studied patients were asserted by the investigator. Explanation of the aim and nature of the study was done to studied patients and the right to refuse participation in the study was emphasized to the patients. Verbal consent was obtained from patients who were participated in the study.

Implementation phase:

- The data collection period extended from January 2023 to June 2023.
- Data was obtained in a catheterization unit from each patient underwent cardiac electrophysiology study during morning shifts.
- The investigator attended the mentioned setting from 9 am to 3pm in the scheduled days of EPS which is two days per week to collect relevant data from studied patients.
- The researcher introduced herself, described the study's goals, and received the patient's verbal consent to take part in the study on a voluntary basis.

- Data collection related to the demographic characteristics of the studied
- Patients were conducted using Tool I, Part (1).
- The clinical data collection for the studied patients was carried out using Tool I, Part (2).
- The investigator monitored the patient during, after the EPS procedure and patients were monitored until discharge.
- Data collection related to Complications were assessed during and after EPS procedure by using Tool II.

Statistical analysis:

The researcher submitted the data through a personal computer. All data underwent analysis using the Statistical Package for the Social Sciences (SPSS) version 26.0 software, and Excel was employed to generate the figures. The researcher examined, classified, and coded the content of each tool. Categorical variables were presented as numbers and percentages, while continuous variables were described using the mean and standard deviation (Mean, SD). The comparison between categorical variables utilized the Chi-square test, and for continuous variables, the t-test was employed. A P-value <0.05 was considered statistically significant.

Results**Table (1): Distribution of demographic data for Studied patients (N=60)**

Variable	No.	%
Gender		
Male	28	46.7
Female	32	53.3
Age group		
Less than 30 years	9	15.0
From 30-40 years	17	28.3
From 40-50 years	23	38.4
More than 50 years	11	18.3
Mean±SD(range)	41.60±11.46(18-65)	
Marital status		
Single	8	13.3
Married	52	86.7
Occupation		
Employer	29	48.3
Dose not work	27	45.0
Retired	2	3.3
House wife	2	3.3
Educational level		
Illiterate	12	20.0
Preparatory school	7	11.7
Secondary school	31	51.7
University	10	16.7
Smoking		
Yes	20	33.3
No	40	66.7

*SD – standard deviations

Table (2): Distribution of Clinical Data for Studied patients (no=60)

Types of arrhythmia	No.	%
SVT	33	55
Accessory pathway	4	6.7
Ventricular tachycardia	3	5.0
PVCS	11	18.3
Sinus tachycardia	9	15.0
Comorbidities		
Non	18	30
Diabetes	8	13.3
Hypertension	15	25
Heart disease	19	31.7
Duration of procedure		
Two hours	18	30.0
From 2-3 hours	27	45.0
More than three hours	15	25.0
Mean±SD (range)	1.94±0.74	
Length of stay		
1 Day	29	48.3
2 Day	28	46.7
From 3 day and More	3	5.0
Mean±SD(range)	1.96± .75	

*SD – standard deviations SVT: supraventricular tachycardia PVCS: premature ventricular contractions

Table (3): Distribution of studied patients according to complications assessment sheet (no. =60)

Complications	Not present		Present	
	No.	%	No.	%
Minor Complication				
Hematoma puncture site	48	80.0	12	20.0
Bleeding	51	85.0	9	15.0
Mild to moderate pericardial effusion	57	95.0	3	5.0
Arteriovenous fistula	60	100.0	0	0.0
Vascular damage	57	95.0	3	5.0
Major Complication				
cardiopulmonary arrest	60	100.0	0	0.0
CVA	60	100.0	0	0.0
Tamponade	60	100.0	0	0.0
AV block	58	96.7	2	3.3
Death	60	100.0	0	0.0
Other major				
DVT	59	98.3	1	1.7

CVA: cerebrovascular accident

AV block: atrioventricular block

DVT: deep venous thrombosis

Table (4): Comparison between patients with and without Complication according to their - demographic data (no=60).

Demographic data	Without Complication(n=35)		With Complication(n=25)		P. value
	No.	%	No.	%	
Gender					
Male	13	37.1	15	60.0	0.116 ^{ns}
Female	22	62.9	10	40.0	
Age group					
Less than 30 years	6	17.1	3	12.0	0.261 ^{ns}
From 30-40 years	8	22.9	9	36.0	
From 40-50 years	12	34.3	11	44.0	
More than 50 years	9	25.7	2	8.0	
Educational level					
Illiterate	7	20.0	5	20.0	0.854 ^{ns}
Preparatory school	5	14.3	2	8.0	
Secondary school	18	51.4	13	52.0	
University	5	14.3	5	20.0	
marital status					
Single	6	17.1	2	8.0	0.304 ^{ns}
Married	29	82.9	23	92.0	
Occupation					
Employer	14	40.0	15	60.0	0.325 ^{ns}
Dose not work	18	51.4	9	36.0	
Retired	1	2.9	1	4.0	
House wife	2	5.7	0	0.0	
Smoking					
Yes	8	22.9	12	48.0	0.040*
No	27	77.1	13	52.0	

* Significant level at P value < 0.05.

ns: no statistically significant difference.

Table (5): Comparison between patients with and without Complication according to their clinical data (n=60).

Clinical data	Without Complication(n=35)		With Complication(n=25)		P. value
	No.	%	No.	%	
Types of arrhythmia					
SVT	18	51.4	15	60.0	0.173 ^{ns}
Accessory pathway	3	8.6	1	4.0	
Ventricular tachycardia	3	8.6	0	0.0	
PVCS	4	11.4	7	28.0	
Sinus tachycardia	7	20.0	2	8.0	
Comorbidities					
Diabetes	5	14.3	3	12.0	0.557 ^{ns}
Hypertension	5	14.3	10	40.0	0.025*
Heart disease	7	20.0	12	48.0	0.022*
Duration of Procedures					
2 hours	12	34.3	6	24.0	0.076 ^{ns}
2 – 3 hours	18	51.4	9	36.0	
More than 3 hours	5	14.3	10	40.0	

* Significant level at P value < 0.05 .

**Significant level at P value < 0.01 .

ns: no statistically significant difference.

SVT: supraventricular tachycardia

PVCS: premature ventricular contractions

As shown in Table (1): This study was conducted on 60 patients with a mean age group (41.60 ± 11.46) years old. Regarding gender, (46.7%) of the studied patients were male, and (53.3%) were female. The majority of studied patients (86.7%) were married. Concerning their educational level, more than three-quarters of the studied patients (80%) were educated. Regarding occupation, (48.3%) of the studied patients were employed. Regarding smoking about two third (66.7) of the studied patients were nonsmokers.

Table (2): Illustrated that more than half of studied patients (55.0%) were diagnosed with SVT. Regarding comorbidities nearly one third of studied patients (31.7%) had a heart disease and more than one fifth (25.0%) had a hypertension. Regarding length of stay nearly half of studied patient (48.3%) were stay one day with mean stay (1.58 ± 0.64). Regarding the duration of the EPS procedure, nearly half of the studied patients (45.0%) underwent a procedure lasting 2-3 hours, with a mean duration of (1.94 ± 0.74) hours.

Table (3): This table illustrates the various of acute complications experienced by patients undergoing EPS. Regarding minor acute complications, about one-fifth of (20.0%) of studied patient had hematoma at puncture site, nine patients (15.0%) had bleeding, three patients (5.0%) had mild to moderate pericardial effusion and three patients (5.0%) had vascular damage. Regarding Major complications, such as AV

block and DVT occurred in around 3.3% and 1.7% of patients, respectively.

Table (4): As shown in that Table, the number of patients with acute complications was 25 (41.7%), and the majority of them (92.0%) were married. Regarding the occupation of patients with complications, about two-thirds (60.0%) were employers. In terms of age group, nearly half (44.0%) of complicated patients fell into the (40-50 years) age group. Moreover, no statistically significant differences were noted between studied patients with and without complications in gender, age, occupation, and educational level ($p > 0.05$). regarding smoking nearly half of the complicated patients (48.0%) were smokers. Additionally, it mentions that there is a statistically significant difference between smokers and non-smokers among the complicated patients.

Table (5): As shown in the table the majority of studied patient (60.0%) diagnosed with SVT, moreover there is no statistical significant differences between complicated and non-complicated patients regarding type of arrhythmia. Regarding comorbidities there is statistical significance differences between patient with and without complication regarding hypertension with P value (0.025) and heart disease with P value (0.022).

Discussion:

The field of cardiac electrophysiology studies has undergone rapid development, shifting its emphasis from diagnostic procedures to interventions. Radiofrequency ablation has now become a prevalent treatment for numerous cardiac arrhythmias. Various complications may occur during or after EPS procedures therefore, identification of these complications and their predictors can help achieving a suitable therapeutic approach for their management. (Shoulders et al., 2016)

The current study was designed to assess acute complication for arrhythmic patient Underwent cardiac electrophysiology study through the following items:

Demographic data:

The current study verified that the highest percentage among studied patients their age group ranged from forty to fifty years old and the majority of them were married. This observation is affirmed by the study done by Mostafa, (2016) who found that, more than half of the studied patients their ages falling between forty to fifty years old and the majority of the examined sample were married.

The current study revealed that more than half of studied sample were females. This observation is supported by the finding in a study carried out by Wood et al., (2017) who found that, more than half of the studied patients were females.

In terms of the participants' educational level, the current study indicates that the majority had finished secondary school. This finding aligns with a study conducted by Amin et al., (2020) where a high percentage of participants also had a secondary education.

Regarding occupation, the results of the current study indicate that almost half of the studied patients were employed. This finding is consistent with the study conducted by Abd Elfattah et al., (2022) who found that, the half of the studied patient were employed.

As regards to smoking; the current study founded that more than two thirds of the studied sample never smoked while approximately one-third were current smokers. These findings are similar to a study conducted by Amin et al., (2020) who found that, about half of the studied sample never smoked and more than one third were quitter.

Regarding clinical data, the highest percentage of studied patients (55.0%) were diagnosed with SVT. this finding is not congruent with Seloma et al., (2019) who mentioned that the approximately one-third of studied patient were diagnosed with VT.

Regarding comorbidities, the current study found that nearly one third, one quarter and nearly one fifth of studied patients had heart disease, hypertension and diabetes respectively. This finding is similar to a

study done by Seloma et al., (2019) who found that, about half, on quarter and fifth of the studied sample had heart disease, hypertension and diabetes respectively.

Regarding duration of cardiac electrophysiology procedure, the current study found that the duration of the procedure of studied patients was (1.94±0.74) hours, this finding in agreement with Schreiber et al., (2015) who reported that duration of procedure of their study participant was (2.23 ± 0.78) days.

Regarding length of stay, the current study found that the length of stay of the studied patients was (1.96±.75) days, this finding in agreement with Abdur Rehman et al., (2019) who reported that length of stay of their study participant was (2.15 ± 3.00) days.

Regarding minor complications, the current study found that the minor complication of studied patients underwent EPS was Hematoma puncture site that not require any surgical intervention, Bleeding that not require medical therapy, mild to moderate pericardial effusion and vascular damage with high percentage of them was hematoma at puncture site. This finding in agreement with Vasheghani et al., (2018) who reported that minor complication was Hematoma puncture site that not require any surgical intervention, Bleeding that not require medical therapy, mild to moderate pericardial effusion and vascular damage respectively with high percentage of minor complication was hematoma at puncture site. in contrast, the current study contradicted with the study conducted by Abdur Rehman et al., (2019) who reported that highest percentage of minor complication was pericardial effusion that requiring pericardiocentesis.

In the context of major complications, the current study established that three percent of the examined patients encountered atrioventricular (AV) block, necessitating pacemaker insertion, while approximately two percent experienced deep vein thrombosis (DVT). This finding aligns with the outcomes of a study by Nakamura et al., (2019), which reported that about two percent of their study participants undergoing EPS developed AV block. Additionally, our study's findings are in harmony with the results of the investigation conducted by Itoga et al., (2020), revealing that around two percent of the studied patients experienced DVT.

The current study demonstrated that there is no statistical significant difference between patients with and without complications regarding demographic data and this is contradicted with result of the study conducted by Abouelatta et al., (2020) who reported that there is statistical significant difference between two groups regarding age and gender with p value (0.001, 0.045) respectively. On

the other hand, the current study consistent with **Vasheghani et al., (2018) & Yang et al., (2017)** who reported that there is no statistical significant difference between two groups regarding gender with p value (0.97, 0.467) respectively.

Concerning smoking, the current study identified a statistically significant difference between patients with and without complications, with a p-value of (0.040). This finding aligns with the results of a study by **Rani et al., (2016)**, which also reported a statistically significant difference between the two groups concerning smoking.

The current study showed that there is statistical significant difference between patients with and without complications regarding hypertension and heart disease and this is consistent with **Wu ta et al., (2021)** who reported that there is statistical significant difference between two groups regarding hypertension and heart disease and also our study contradiction with result of the study conducted by **Lin et al., (2019)** who reported that there is statistical significant difference between two groups regarding hypertension and heart disease.

Conclusion:

Cardiac electrophysiology studies demonstrated a low incidence of complications, with hypertension, heart disease, and smoking identified as potential risk factors. Overall, EPS appears to be a safe procedure for diagnosing and treating cardiac arrhythmias.

Recommendation:

- Develop and implement protocol for nurses, who are integral in patient care, regarding the acute complications associated with cardiac electrophysiology studies for early recognition and management.
- Application of the current study with more participants in other locations around Egypt to generalize the findings

References:

- **Abdur Rehman, K., Wazni, O., Barakat, A., Saliba, W. I., Shah, S., Tarakji, K. G., & Hussein, A. (2019):** Life-threatening complications of atrial fibrillation ablation: 16-year experience in a large prospective tertiary care cohort. *JACC: Clinical Electrophysiology*, 5(3), 284-291.
- **Abouelatta, M., EL-damaty, A., EL-naggar, W., & hassan, A. (2020):** Predictors and Characteristics of Atrial Fibrillation Induced During Supraventricular Tachycardia Ablation Procedures. *The Medical Journal of Cairo University*, 88(3), 805-813.

- **Amin, H., Ahmed, O., Mahedy, N., Ibraheem, M., & Abdellah, A. (2020):** Assessment of level of Knowledge and Practice of Patients Undergoing Cardiac Catheterization. *Port Said Scientific Journal of Nursing*, 7(4), 155–183.
- **Chaudhary, M., Dev, S., Kumari, A., Kanwal, K., Jadav, D., Rasool, S., & Mohamad, T. (2023):** Holistic approaches to arrhythmia management: combining medication, ablation, and device interventions. *Cureus*, 15(9): e45958. doi:10.7759/cureus.45958
- **El-Aty, A., Abozead, S., El-All, A., & Abd El-Razik, H. (2018):** Assessment of Nurses' Knowledge and Practice Regarding Care of Patients Undergoing Percutaneous Coronary Intervention. *Assiut Scientific Nursing Journal*, 6(15), 29-35.
- **Elliott, A., Middeldorp, M., Van Gelder, I., Albert, C., & Sanders, P. (2023):** Epidemiology and modifiable risk factors for atrial fibrillation. *Nature Reviews Cardiology*, 20(6), 404–417
- **Gillingham, I. (2018):** Diagnostic Investigations the Electrophysiology Study, *British Journal of Cardiac Nursing*, 13(5), 220-228.
- **Itoga, N., Rothenberg, K., Deslarzes-Dubuis, C., George, E., Chandra, V., & Harris, E. (2020):** Incidence and risk factors for deep vein thrombosis after radiofrequency and laser ablation of the lower extremity veins. *Annals of vascular surgery*, 6(2), 45-50.
- **Jain, N. (2021):** Survey versus interviews: Comparing data collection tools for exploratory research. *The Qualitative Report*, 26(2), 541-554.
- **Abd Elfattah, M., Ahmed Abdellatif, S., & Mohamed Barakat, M. (2022):** Psychological Problems and Quality of Life among Patients Undergoing Heart Procedures. *Journal of Nursing Science Benha University*, 3(1), 694-705.
- **Kotake, Y., Huang, K., Bennett, R., De Silva, K., Bhaskaran, A., Kanawati, J., Turnbull, S., Zhou, J., Campbell, T., & Kumar, S. (2023):** Efficacy and safety of catheter ablation as first-line therapy for the management of ventricular tachycardia. *Journal of Interventional Cardiac Electrophysiology*. Pp1-11. <https://doi.org/10.1007/s10840-023-01483-2>.
- **Lin, Y., Wu, H., Wang, T., Chen, T., & Lin, Y. (2019):** Trend and risk factors of recurrence and complications after arrhythmias radiofrequency catheter ablation: a nation-wide observational study in Taiwan. *BMJ open*, 9(5), 20-24.
- **Majeed, H., & Sattar, Y. (2022):** Electrophysiologic Study Indications and Evaluation. *StatPearls*, 7(15), 24-56

- **Marry, A., & Adrienne, D. (2019):** Medical surgical nursing, chapter (6), 7th ed., Elsevier, Pp.593-601.
- **Moatammed Abozeid, H., Ghanem, H., Ahmed, A., & Abdelall, H. (2023):** Knowledge of Patients with Arrhythmia Undergoing Cardiac Electrophysiology Study. Assiut Scientific Nursing Journal, 11(37), 77-86.
- **Mostafa, F., Sherif, W., & Hassanin, A. (2016).** Effect of health education guidelines to prevent complications associated therapeutic cardiac catheterization at specialized medical hospital of mansoura. Mansoura Nursing Journal, 3(1), 249-265.
- **Nakamura, T., Narui, R., Zheng, Q., Yarmohammadi, H., Tedrow, U., Koplan, B., & John, R. (2019):** Atrioventricular block during catheter ablation for ventricular arrhythmias. JACC: Clinical Electrophysiology, 5(1), 104-112.
- **Padia, S., Genshaft, S., Blumstein, G., Plotnik, A., Kim, G., Gilbert, S., & Stavrakis, A. (2021).** Genicular artery embolization for the treatment of symptomatic knee osteoarthritis. JBJS Open Access, 6(4),15-19
- **Rani, S., Lakshmi, R., Pillai, A., & Nisha, S. (2016):** The risk factors associated with complications of coronary angiogram: A cross-sectional observational study. International Journal of Advanced Medical and Health Research, 3(1), 11-15.
- **Reinisch, C., Hagler, D., Roberts, D., Kwong, J., &Harding, M. (2019):** Lewis's medical surgical nursing, Chapter (30), 11th ed., Elsevier, Pp.673-682.
- **Schreiber, D., Rostock, T., Fröhlich, M., Sultan, A., Servatius, H., Hoffmann, B., & Steven, D. (2015):** Five-year follow-up after catheter ablation of persistent atrial fibrillation using the stepwise approach and prognostic factors for success. Circulation: Arrhythmia and Electrophysiology, 8(2), 308-317.
- **Seloma, Y.A. (2019):** Cardiac electrophysiology study: critical care nurse's knowledge, practices and patient's state-trait anxiety level at a selected hospital in cario, International Journal of Novel Research in Healthcare and Nursing, 6 (2),684-698
- **Shoulders, B., Mauriello, J., Shellman, T., & Follett, C. (2016):** Cardiac radiofrequency ablation: a clinical update for nurses, Dimensions of Critical Care Nursing, 5(5), 255-267.
- **Vasheghani-Farahani, A., Shafiee, A., Akbarzadeh, M., Bahrololoumi-Bafraee, N., Alizadeh-Diz, A., Emkanjoo, Z., & Haghjoo, M. (2018):** Acute complications in cardiac electrophysiology procedures: A prospective study in a high-volume tertiary heart center. Res Cardiovasc Med, 3(7), 20-5.
- **Vyas, C., & VMurti, S (2023):** Cardiac Electrophysiology and Radiofrequency Ablation In Advanced Apex Tertiary Care Centre: A Seven Year Retrospective Study. International Journal of Life Sciences, 12(2), 1970-1975.
- **Wood, K., Barnes, A., Paul, S., Hines, K., & Jackson, K. (2017):** Symptom challenges after atrial fibrillation ablation. Heart & Lung, 46(6), 425-431.
- **Wu, L., Narasimhan, B., Ho, K., Zheng, Y., Shah, A., & Kantharia, B. (2021):** Safety and complications of catheter ablation for atrial fibrillation: predictors of complications from an updated analysis the National Inpatient Database. Journal of Cardiovascular Electrophysiology, 32(4), 1024-1034.
- **Yamada, T., Matsubara, Y., Washimi, S., Hashimoto, S., Hata, T., Taniguchi, N., & Takahashi, A. (2022):** Vascular Complications of Percutaneous Coronary Intervention Via Distal Radial Artery Approach in Patients with Acute Myocardial Infarction with and Without ST-Segment Elevation. Journal of Invasive Cardiology, 34(4).
- **Yang, E., Ipek, E., Balouch, M., Mints, Y., Chrispin, J., Marine, J., & Spragg, D. (2017):** Factors impacting complication rates for catheter ablation of atrial fibrillation from 2003 to 2015. EP Europace, 19(2),241-250

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