Original Article

Assessment of knowledge and practice of cardiovascular nurses regarding warfarin

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Abstract:

BACKGROUND: Despite new anticoagulants' developments, warfarin is still one of the most commonly used medicines, particularly in the cardiovascular system. One of the significant challenges with warfarin is the prevalence of dangerous side effects such as bleeding and drug and food interactions, which can negatively affect patients if not adequately controlled. As health-care team members, nurses have a crucial role in prescribing this medicine and educating patients. In this regard, this study was conducted to determine the knowledge and practice of nurses working in the cardiovascular wards regarding warfarin.

MATERIALS AND METHODS: In this cross-sectional, descriptive study, knowledge and practice of 239 nurses working in the cardiovascular wards of teaching hospitals affiliated to Iran University of Medical Sciences have been investigated using European Cardiovascular Nurses Knowledge questionnaire on anticoagulants and the checklist for high-risk drugs safety instructions. The sampling was performed through the stratified sampling method with proportional allocation. Data were analyzed using the SPSS software version 16 through descriptive and inferential statistics (independent t-test, one-way analysis of variance, and Pearson correlation coefficient) (Inc., Chicago, IL, USA).

RESULTS: The mean scores of knowledge (18.51 ± 3.87) and practice (10.53 ± 2.12) were slightly higher than the median, and the lowest mean score was related to knowledge on drug interactions (7.62). The practice had a statistically significant relationship with knowledge ($P < 0.001$). Regarding demographic variables, there was a statistically significant relationship between nurses' knowledge and the education level ($P = 0.009$) and nurses' practice and age ($P = 0.022$), work experience ($P = 0.032$), and work experience in cardiovascular wards ($P = 0.036$).

CONCLUSIONS: Based on the findings of this study, the knowledge of nurses working in the cardiovascular wards about warfarin was not sufficient, and their practice was of poor quality. Nurses' lack of knowledge and improper practice can jeopardize drug safety in patients and cause serious side effects such as bleeding. Proper training of nursing students and nurses about warfarin as a high-risk drug, its side effects, and drug-food interactions, and the emphasis on patient education in patients receiving this medicine can effectively reduce the incidence of side effects.

Keywords:

Anticoagulants, knowledge, nurse, practice patterns, warfarin

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Introduction

For the past six decades, Vitamin K antagonists have been a treatment for thromboembolic problems.[1] However, warfarin is the most commonly used medication for most cardiovascular diseases, such as atrial fibrillation rhythm, mechanical heart valves, pulmonary embolism, and deep-vein thrombosis.[2,3] In addition to its benefits, including reducing the risk of thrombotic events, it has disadvantages, such as bleeding, multiple interactions with drugs, herbs, and foods, and brain stroke

risk, which necessitates the continuous monitoring of coagulation tests and dose adjustment.[4,5] According to studies, bleeding is the most common side effect, even with the international normalized ratio (INR) within the therapeutic range.[6] Indeed, it increases the risk of extensive bleeding by 0.5% and the risk of intracerebral hemorrhage by 0.2% annually.[7]

The warfarin dose should be meticulously adjusted to achieve maximum effectiveness and maintain patient safety by measuring INR.[8,9] Since INR is affected by the pharmacodynamic interactions of warfarin and its interactions with foods, herbs, and drugs, achieving a stable INR is highly challenging. It significantly depends on patients and their caregivers.[10,11] In addition, the amount of Vitamin K that patients consume is different depending on their diet and because of that, there are a lot of fluctuations in INR level and anticoagulation outcomes.[12] Hence, these interactions with no adherence to the therapeutic regimen are the synergic factors which make reaching an stable INR even more challenging.[13]

According to these factors, successful anticoagulation treatment highly depends on the patient's knowledge of the drug and its interactions which can result in moderating diet behavior and adherence to medication.[14] It should be noted that the knowledge of patient caregivers is also essential.[11] Nurses' role as patient caregivers in hospitals is critical in controlling medical history and INR to administer the correct dose, consulting and referring the patients to the physician, and educating them.[15,16]

Treatment with warfarin requires nurses to provide constant patient care and has sufficient knowledge and skill, as it is one of the medications with the highest rate of side effects and can lead to adverse effects in patients.[17,18] Therefore, the lack of knowledge and improper practice can lead to inaccurate patient counseling and inappropriate therapeutic results,[19] including medication errors, which are among the most common types of medical errors. These errors result in 180,000 deaths in the United States and 185,000 hospitalizations in Canada per year, of which 70,000 are preventable.[20] In Iran, based on the study by Joolaee *et al*., the average incidence of medication errors for each nurse within 3 months is estimated to be 19.5.[21] In addition, the research results by Farzi *et al.* illustrated that the participation of nurses with inadequate knowledge in the medication process is the leading cause of medication errors.[22]

Due to the critical role of health-care professionals in preventing medication errors and improving patients' safety as a principle, various studies in Sydney, Norway, and Saudi Arabia investigated medical staff's knowledge about anticoagulants, their interactions, and side effects, which indicated that all staff subgroups had neither sufficient knowledge nor proper practice.[18,23]

Regarding the necessity of proper knowledge and practice of nurses to accurately prescribe warfarin and prevent its hazardous consequences such as medication errors, this study aimed to determine the knowledge and practice of cardiovascular nurses working in teaching hospitals affiliated to Iran University of Medical Sciences regarding warfarin.

Materials and Methods

Study design and setting
In this cross-sectional descriptive study, samples were selected from the nurses working in the cardiovascular wards of ten teaching hospitals affiliated to Iran University of Medical Sciences. The study setting included internal cardiac medicine, cardiac surgery, cardiac care unit (CCU), post-CCU, and heart transplant wards.

Study participants and sampling
The sampling was performed from October to December of 2020. Determining the required sample size at a 95% confidence level and estimated accuracy of d = 0.5 and a standard deviation of 6 according to Otherhals *et al*. (2014), the minimum required sample size was estimated as 239 individuals. The stratified sampling method with proportional allocation was used so that the proportion of the nurses working in each hospital determined the number of samples selected from that hospital. After providing initial explanations about the objectives and receiving written consent, the researcher provided the questionnaire to nurses. Similarly, to investigate the nurses' practice, the researcher completed the checklist. The inclusion criteria included holding at least a bachelor's degree in nursing and 6 months of work experience in the cardiovascular ward.

Data collection tool and technique
The two tools were used to collect the data: 1. *European cardiovascular nurses' knowledge on anticoagulants questionnaire* designed by Oterhals *et al*.[24] It consisted of four sections and 47 questions. The sections included nurses' demographic information, oral anticoagulant therapies, oral anticoagulant therapies with warfarin, and new anticoagulants. The maximum, minimum, and median of this tool were 52, 0, and 26, respectively. After obtaining consent from the designer, the questionnaire was translated into Persian by a translator expert in translating the medical text using the forward-backward translation method. To fully ensure that the translation corresponds to the English text, the translated version was interpreted into English by another translator fluent

in English who had not previously seen the original questionnaire. Afterward, for the final approval, the translated final English version was sent to the designer. After approval, the researcher used the Persian version. The questionnaire was provided for six faculty members and a pharmacist to determine the content validity. Following that, to make a preliminary evaluation of face validity, it was provided to ten nurses with at least 6 months of experience based on the inclusion criteria. These nurses were working in the sampling sites, and they expressed comments on the clarity, transparency, writing style, grammar, and ease of completing this tool. Kuder – Richardson Index 21 was used to determine this tool's internal reliability, which was 0.615 for drug interactions, 0.802 for food interactions, 0.763 for the management of warfarin therapy, and 0.835 for the whole tool.

High-risk drugs safety instructions program checklist (questions related to warfarin) was designed by Esfahani *et al.*[25] This checklist examines nurses' practice on warfarin and consists of eight items on practice in preventing medication errors and ten items on practice in preventing adverse drug events. The content and face validity of the checklist was determined similar to the previous questionnaire. This checklist's reliability was determined by two simultaneous observers. The correlation coefficient between two evaluators was 0.923 for practicing medication errors, 0.987 for preventing adverse drug events, and 0.962 for the whole checklist. Data analysis was performed using the SPSS software version 16 (Inc., Chicago, IL, USA) by the descriptive and inferential statistics (independent *t*-test, one-way, analysis of variance, and Pearson correlation coefficient tests).

Ethical considerations

The ethics committee of the Iran University of Medical Sciences has approved this study (IR.IUMS.REC.1399.608). After explaining the objectives, oral and written consent was obtained to observe ethical principles, emphasizing the confidentiality of information.

Results

Table 1 shows all information about the demographic characteristics of samples. Participants chose warfarin as the most widely used anticoagulant with a 91.6% rate among others. Regarding changing patients' medications, 56.5% of the nurses expressed that it would be replaced by another medication in patients who have problems maintaining the dose at the therapeutic level. Regarding patient education, 84.1% of nurses stated that they would teach patients about the medicines, how to use them, and possible side effects, and 55.6% stated that nurses and other health care providers

Table 1: Frequency distribution of demographic characteristics of the studied nurses

Demographic characteristics	Frequency (%)
Sex	
Female	171 (71.5)
Male	68 (28.5)
Total	239 (100)
Education	
Bachelor	194 (81.2)
Master	45 (18.8)
Total	239 (100)
Current position	
Nurse	206 (86.2)
Advanced practice nurse	26 (10.9)
Head nurse- nurse manager	7 (2.9)
Total	239 (100)
Direct patient care	
Direct	237 (99.2)
Indirect	2 (0.8)
Total	239 (100)
Main specialty department	
Internal cardiac medicine	66 (27.6)
Cardiac surgery	15 (6.3)
Transplantation	2 (0.8)
CCU	121 (50.6)
Post-CCU	35 (14.6)
Total	239 (100)
Place of work primarily	
Inpatient	227 (95)
Inpatient and outpatient	12 (5)
Total	239 (100)
Age (years)	
Mean±SD	34.37±7.11
Maximum-minimum	55-22
Years of practice (years)	
Mean±SD	10.14±6.41
Maximum-minimum	29-1
Years of practice in cardiac wards (years)	
Mean±SD	6.77±6.14
Maximum-minimum	6 month-27

SD=Standard deviation, CCU=Coronary care unit

would advise patients on the warfarin dose according to the INR.

Nurses' knowledge about warfarin

Nurses' knowledge was examined in four sections, 3 of which were about warfarin drug interactions, food interactions, and treatment management, and one section was about knowledge about new anticoagulants. Table 2 shows the nurses' knowledge about the warfarin interactions. Regarding food interactions, more than half of the nurses were fully aware that warfarin interferes with broccoli (79.9%) and coleslaw (61.9%). Regarding warfarin treatment management, in general, 50.6% of the participants knew that patients were allowed to use spinach while taking warfarin; however, they were required to consume the same amount every week, and

58.2% of the participants had the knowledge that the use of alcohol leads to an increased INR. The vast majority of participants (91.2%) realized that the most preferred time to take warfarin was in the evening, and 76.2% knew that the INR needs to be checked at least once a month.

Regarding missed doses, 57.3% of nurses correctly answered that the patient should ignore the missed doses. Furthermore, 79.9% of the participants knew that warfarin takes 5 days to be removed from the patient's body. About the duration of treatment with warfarin, 86.2% recognized that this time varies depending on patients' condition; however, about consuming this medicine during pregnancy, only 35.6% were aware that it could be safely used during the second and third trimesters of pregnancy.

Regarding nurses' knowledge of new anticoagulants, of all participants, 40.2% and 51.5% had the knowledge that 150 and 110 mg doses were the approved doses of Dabigatran, respectively. Besides, 42.3% of the participants knew that 110 mg is the approved dose for the elderly. Regarding the indications for taking this medicine, 47.7% of nurses knew that atrial fibrillation was the appropriate indication. In this research, 67.8% of nurses were aware that taking dabigatran does not require laboratory tests. Furthermore, 24.3% of nurses could recognize that 80% of dabigatran is excreted through the kidney and 35.1% had the knowledge that the rate of bleeding is much lower with dabigatran as compared to warfarin.

The total obtainable score in the questionnaire was 52; the mean score obtained by the nurses was 27.07 ± 9.26. An independent *t*-test was performed to examine the relationship between the knowledge and demographic variables, which indicated that higher educated nurses had more knowledge about anticoagulants (*P* = 0.009).

Nurses' practice regarding warfarin
The mean score obtained by nurses in the practice checklist was 10.53 ± 2.12. Pearson correlation coefficient was used to investigate the relationship between practice and demographic variables, which showed that nurses' practice was associated with age (*P* = 0.022), work experience (*P* = 0.032), and work experience in cardiac wards (*P* = 0.036).

Relationship between nurses' knowledge and practice
Pearson correlation coefficient was used to investigate the relationship between nurses' knowledge and practice. This study showed a statistically significant relationship between nurses' knowledge and practice and their subscales (*P* < 0.001). Table 3 demonstrates these relationships.

Discussion

This study aimed to determine the knowledge and practice of cardiovascular nurses regarding warfarin.

This study showed that warfarin is still the most commonly used anticoagulant, and nurses reported that they used warfarin as the first option in their daily practice. This finding had already been reported in numerous studies.[24,26-29] About the other anticoagulant rate of usage, they reported Xalerban and Dabigatran as the second and third one. Unlike our study, a study by Rodwin *et al*., investigating the use of anticoagulants between 2010 and 2014, found that the prescription rate of warfarin decreased while the prescription rate of direct oral anticoagulant (DOAC) increased.[30] This difference is probably attributed to the fact that most

Table 2: Frequency distribution of nurse's knowledge related to warfarin interactions

Name of the drug	Warfarin interactions, frequency (%)			
	Enhance	**Inhibit**	**No effect**	**Don't know**
Aspirin	204 (85.4)	7 (2.9)	23 (9.6)	5 (2.1)
Ibuprofen	138 (57.7)	31 (13)	49 (20.5)	21 (8.8)
Topical salicylates	109 (45.6)	21 (8.8)	62 (25.9)	47 (19.7)
Propranolol	81 (33.9)	12 (5)	85 (35.6)	61 (25.5)
Cholestyramine	23 (9.6)	111 (46.4)	40 (16.7)	65 (27.3)
Atenolol	32 (13.4)	19 (7.9)	109 (45.6)	79 (33.1)
Antacids	86 (36)	76 (31.8)	39 (16.3)	38 (15.9)
Cimetidine	119 (49.8)	46 (19.3)	24 (10)	50 (20.9)
Metamucil	31 (13)	28 (11.7)	67 (28)	113 (47.3)
Sucralfate	45 (18.8)	67 (28)	30 (12.6)	97 (40.6)
Multivitamin	100 (41.8)	54 (22.7)	51 (21.3)	34 (14.2)
Multivitamin and minerals	86 (36)	57 (23.8)	52 (21.8)	44 (18.4)
Antioxidant formula	40 (16.7)	65 (27.3)	56 (23.4)	78 (32.6)
1200 IU Vitamin E	122 (51)	42 (17.6)	27 (11.3)	48 (20.1)
1000 mg Vitamin C	84 (35.1)	82 (34.3)	21 (8.8)	52 (21.8)
Anti biotics	92 (38.5)	37 (15.5)	56 (23.4)	23 (9.6)

Table 3: Relationship between nurse's knowledge and practice about warfarin - 1399

Nurse's knowledge about warfarin	Nurse's practice on warfarin, *r* (*P*)		
	Practice in the prevention of drug errors	**Practice in the prevention of adverse drug events**	**Practice**
Knowledge about warfarin	0.135 (0.37)	0.241 (<0.001)	0.237 (<0.001)
Knowledge about the new anticoagulant	0.219 (0.001)	0.220 (0.001)	0.262 (<0.001)
Knowledge	0.209 (0.001)	0.271 (<0.001)	0.294 (<0.001)

patients treated with DOAC do not need hospitalization to reach the therapeutic dose and our study was done only in inpatient centers. It is also necessary to mention that nurses strongly emphasized on their unique role in educating patients about anticoagulants, as other studies had stated this before.[24,26]

As nurses' main tasks are caring out medication orders and educating patients; they need to have sufficient knowledge about anticoagulants to perform these tasks adequately.[16,31] In addition, they are required to perform tasks such as controlling the patient's medical history and INR to ensure the correct dose administration, consulting patients, referring them to the physician according to their needs, and educating them.[16,31] However, this study showed that nurses' knowledge about warfarin in the various aspects of treatment management with this medicine and its food and drug interactions has shortcomings, with the lowest score obtained in drug interactions. For example, it is worrying that two-third of them did not know the exact interaction between warfarin and propranolol as a commonly used cardiac agent. In therapy management with this drug, the level of knowledge was slightly better but still, the fact that only about one-third of nurses know that warfarin can be used safely during the second and third trimesters of pregnancy can be worrying.

This study evaluated cardiovascular nurses who were expected to have better knowledge about anticoagulants compared to others nurses. Other studies that examined nurses' knowledge about anticoagulants are in line with the present study and have identified the need for training programs for different medical staff.[24,26,32] Moreover, a study examining the knowledge of different health-care providers, including nurses, physicians, and pharmacists, about the oral anticoagulants indications, dosage, their prescribing, and maintenance showed that their knowledge is not sufficient in this regard, and it is necessary to develop programs to strengthen patient safety.[33] In addition, a study found that most nurses had inappropriate knowledge about the anti-coagulation regimen and their interactions.[34] Medication administration is one of the most common tasks that nurses perform during their daily duties, and they should have sufficient knowledge and appropriate attitude and competence towards this task.[35]

The results of determining nurses' practice showed that their practice was not of good quality. Due to the importance of warfarin and its lethal side effects and narrow therapeutic index, it was expected that the practice of the cardiovascular nurses would have higher quality. This was assessed in two parts and the lowest score was related to performance in the prevention of adverse drug events regarding warfarin. Abd Elrahman Yones *et al*. also highlighted the deficiency in nursing practice in their research.[18] The samples of our study were cardiovascular nurses and it was expected these nurses had proper practice about warfarin as a main drug of patients with heart diseases, but the results showed otherwise. Therefore, it is probably anticipated that the quality of practice could be even worse among general nurses.

Furthermore, this study examined the various aspects of nurses' practice and based on the results, one of the weakest aspects of which was patient education about warfarin. One of the main components of patient-centered care is effective education which requires knowledge and skill. Nurses can improve their ability to educate patients by acquiring knowledge and applying the knowledge for teaching of patients.[36,37] Improper function about patient education in nurses can be related to poor understanding, ignorance, lack of time, lack of training, and inadequate adherence to evidence-based guidelines. Therefore, it is required to emphasize on effective decisions for anticoagulation therapy policy and current practical guidelines.[18] In line with our study, the study conducted by Cheragi *et al*. in Iran found that the nurses' practice regarding high-risk drugs such as warfarin was of poor quality.[38] The studies conducted in *Saudi Arabia* and *Morocco* on nurses' practice on medication errors likewise concluded that the knowledge of medical staff, including nurses, physicians, and pharmacists about anticoagulants was insufficient.[18,39]

The results showed that nurses' knowledge had a statistically significant relationship with their clinical practice ($P < 0.001$), and there was also a statistically significant relationship between subscales of knowledge and practice. Nurses must have sufficient knowledge to provide appropriate care in their clinical practice. This finding is consistent with numerous studies, such as a study in Egypt indicating that nurses' knowledge about anticoagulants was associated with their practice and attitude.[18] The results of other studies show that nurses' knowledge deficiency can cause medication errors in clinical practice, and the safe administration of drugs is associated with proper clinical knowledge, attitude, and judgment which still emphasize on the fact that practice is highly related to knowledge.[40,41]

Nurses' knowledge has significant relationship with their education level ($P = 0.009$). In other words, nurses with higher levels of education had better knowledge about warfarin. It can be argued that the education level is a crucial factor in achieving knowledge.[42] Higher education is associated with more training, passed

courses, and up-to-date information that can lead to a better level of knowledge. Contrary to the present study, in a study conducted by Oterhals *et al.* in Norway, it was concluded that knowledge about anticoagulants decreased in nurses with higher education.[24] In the study by Abd Elrahman Yones *et al.* (2019), no statistically significant relationship was found between nurses' demographic characteristics and their knowledge about anticoagulants. These differences may be related to the demographic characteristics of the studied samples. This study only examined nurses working in the cardiovascular wards, while nursing who were not involved in direct care of patients were also assessed in other studies.

The results show that nurses' practice is relevant with their age (*P* = 0.022), work experience (*P* = 0.032), and work experience in cardiovascular wards (*P* = 0.036). It can be stated that nurses gain experience over time by working in clinical settings and practicing tasks improves the quality of their practice. This finding is in line with the study by Bayoumi *et al.* (2014)[43] In the contrast to our study, Abd Elrahman Yones *et al.* concluded that there is no statistically significant relationship between nurse demographic information and their practice.[18] This difference can be related to the different means of age, work experience, and work experience in cardiovascular wards between the study samples, which was higher in our study.

Limitations and recommendation

One of the limitations was the COVID-19 pandemic at the time of sampling, which caused many wards to be merged, and the number of nurses working in the cardiovascular wards was reduced; therefore, it is recommended that this study be conducted in noncritical situations. Other limitations included the sampling method, which was a continuous, not a random method. Since it can affect the research's generalizability, we recommend conducting this study through random sampling to achieve more reliable findings. In addition, the possibility of change in participants' behavior due to their awareness of the observer's presence when completing the checklist is another limitation affecting the results. The researchers made an effort to reduce this effect by spending more time in each ward to fill in checklists.

Since in the present study, nurses' knowledge and practice about anticoagulants were insufficient, and on the other hand, they usually do not have enough time to participate in face-to-face classes. It is recommended that a study examine the effect of virtual training in this regard. For as much as nurses' knowledge and practice about anticoagulants can affect the side effects of these drugs in patients, a study should examine the relationship between nurses' knowledge and practice about anticoagulants and the rate of patient hospitalization due to these drug side effects.

Conclusions

The cardiovascular nurses' knowledge and practice about warfarin have shortcomings, as neither of the two indicators is of good quality despite the importance and risks of this medicine. The lack of knowledge and practice can lead to inaccurate patient counseling, increased side effects of drugs, and high treatment costs. Therefore, these problems can be solved to a certain degree with appropriate training, leading to increased knowledge and improved nursing practice regarding anticoagulants, especially in the cardiovascular wards.

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Conflicts of interest

There are no conflicts of interest.

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