

Rational Drug Use in Preoperative and Postoperative Care: Improvement in Nurses' Knowledge of Use of Novel Oral Anticoagulants (NOACs)



Ameliyat Öncesi ve Sonrası Bakımda Akılcı İlaç Kullanımı:
Hemşirelerin Yeni Nesil Oral Antikoagülanlar (YOAK) Konusundaki Bilgi Düzeylerinin Artırılması

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Abstract

Objective: This study was conducted as a single-group, pre-test and post-test design, to determine the knowledge levels of nurses about Novel Oral Anticoagulants (NOACs) given before and after surgery and to examine the effect of the training provided on their knowledge levels.

Method: The research was conducted with a total of 70 nurses working in a foundation university hospital between November and December 2022. Data was collected with a questionnaire. The educational intervention consisted of ten 45-minute group sessions. The effectiveness of the training was re-evaluated with a questionnaire after two weeks.

Results: The pre-test and post-test results showed a statistically significant improvement in knowledge scores, from 4.74 ± 1.87 to 11.51 ± 1.46 ($p < 0.001$). While knowledge improvement was not statistically significant associated with education level, professional experience, or clinical department, nurses with 6-10 years of experience in their current clinical setting scored higher than those with 1-5 years of experience ($p = 0.018$).

Conclusion: It has been determined that the new generation oral anticoagulant training given to nurses increased their knowledge and awareness about NOAC. In line with this result, it is recommended that similar, comprehensive and continuous training programs be organized for nurses on NOAC drug administration.

Keywords: education; novel oral anticoagulants; nurse; preoperative care; postoperative care

Özet

Amaç: Bu çalışma, hemşirelerin ameliyat öncesi ve sonrası verilen Yeni Nesil Oral Antikoagülanlar (YOAK) hakkındaki bilgi düzeylerini belirlemek ve verilen eğitimin bilgi düzeyleri üzerindeki etkisini incelemek amacıyla tek gruplu, ön test ve son test tasarımı ile yapılmıştır.

Yöntem: Araştırma, Kasım-Aralık 2022 tarihleri arasında bir vakıf üniversitesi hastanesinde çalışan toplam 70 hemşire ile gerçekleştirilmiştir. Veriler, bir anket aracılığıyla toplanmıştır. Eğitim müdahalesi, on adet 45 dakikalık grup oturumundan oluşmuştur. Eğitimin etkinliği, iki hafta sonra yeniden bir anket ile değerlendirilmiştir.

Bulgular: Ön test ve son test sonuçları, bilgi puanlarının istatistiksel olarak anlamlı derecede iyileştiğini göstermiştir; puanlar $4,74 \pm 1,87$ 'den $11,51 \pm 1,46$ 'ya yükselmiştir ($p < 0,001$). Bilgi düzeylerindeki artışın eğitim düzeyi, mesleki deneyim veya klinik departman ile istatistiksel olarak anlamlı bir ilişkisinin olmadığı, ancak mevcut klinik ortamda 6-10 yıl deneyime sahip hemşirelerin, 1-5 yıl deneyime sahip olanlara göre daha yüksek puanlar aldığı bulunmuştur ($p = 0,018$).

Sonuç: Hemşirelere verilen yeni nesil oral antikoagülan eğitiminin, YOAK konusunda bilgi ve farkındalıklarını artırdığı belirlenmiştir. Bu sonuç doğrultusunda, hemşirelere YOAK ilaç uygulamaları konusunda benzer, kapsamlı ve sürekli eğitim programlarının düzenlenmesi önerilmektedir.

Anahtar Sözcükler: eğitim; yeni nesil oral antikoagülanlar; hemşire; ameliyat öncesi bakım; ameliyat sonrası bakım

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Introduction

Nurses play a critical role in ensuring the care of patients during the preoperative, intraoperative, and postoperative phases. Each of these phases encompasses a wide range of responsibilities, from preparing patients for surgery to managing their recovery after the procedure. The management of bleeding risk, particularly in surgical interventions, stands out as an area where the knowledge and skills of nurses are of paramount importance. In this context, the use of oral anticoagulants holds a critical position, both in reducing bleeding risk and in preventing thromboembolic complications (1).

Rational drug use is a critical component in optimizing patient outcomes, particularly in the context of pre- and post-operative care. The effective management of medication, especially anticoagulants, plays a vital role in preventing complications such as thromboembolism, which is a significant risk in surgical patients. NOACs have revolutionized anticoagulation therapy, offering several advantages over traditional vitamin K antagonists, including fewer drug interactions, no routine monitoring requirements, and a more predictable pharmacokinetic profile (2). However, the successful integration of NOACs into clinical practice depends heavily on healthcare professionals, particularly nurses, having a thorough understanding of these medications.

Nurses are often the primary healthcare providers responsible for administering anticoagulants and monitoring patients for adverse effects or signs of bleeding. Therefore, their knowledge and understanding of NOACs are crucial for ensuring patient safety and effective anticoagulation management (3). Despite the clinical advantages offered by NOACs, studies indicate that nurses' knowledge regarding the use of these drugs is often inadequate, potentially leading to suboptimal patient care and increased risk of complications (4).

The shift from traditional anticoagulants, such as warfarin, to NOACs has introduced new challenges in clinical practice. NOACs, including dabigatran, rivaroxaban, apixaban, and edoxaban, have different mechanisms of action, pharmacodynamics, and pharmacokinetics compared to warfarin, which necessitates a

different approach to their management (6). For instance, while warfarin's effects can be monitored using INR, NOACs do not require such monitoring, which can lead to uncertainty among nurses about how to assess and manage these patients appropriately. Furthermore, the reversal of anticoagulation in cases of emergency surgery or major bleeding presents additional complexities, as specific antidotes are only available for some NOACs (7).

Education and training programs targeted at enhancing nurses' knowledge of NOACs are essential for improving the quality of care in surgical settings. These programs should cover various aspects, including the pharmacology of NOACs, indications, contraindications, potential drug interactions, and the management of bleeding complications (7). Effective education can not only improve knowledge but also enhance nurses' confidence in managing patients on NOACs, thereby reducing the incidence of medication errors and improving patient outcomes (8).

Recent studies have demonstrated the positive impact of structured educational interventions on nurses' knowledge and competency in managing patients on NOACs. For example, a study by Ehsani et al. (2022) found that nurses who participated in a NOAC-focused educational program showed significant improvements in their understanding of drug interactions, proper dosing, and the management of adverse effects (9). Similarly, Kim et al. (2020) reported that ongoing education and regular updates about NOACs were associated with improved patient outcomes, including reduced rates of bleeding complications and thromboembolic events (3).

However, the use of NOACs in surgical patients introduces new knowledge and skill requirements for nurses. The correct administration of these drugs during the perioperative and postoperative periods plays a critical role in reducing the risk of complications. The level of knowledge that nurses possess about these medications is vital for their proper management and for ensuring patient safety. Inadequate or incorrect information can lead to undesirable outcomes, such as significant bleeding risks or insufficient anticoagulation.

In conclusion, as the use of NOACs continues to increase in pre- and post-operative care, it is imperative to ensure that nurses are well-informed and equipped to manage these medications safely and effectively. Educational interventions that focus on the unique aspects of NOACs can bridge the knowledge gap and empower nurses to deliver high-quality, evidence-based care. By enhancing nurses' knowledge, we can improve patient safety, optimize therapeutic outcomes, and reduce the risk of complications associated with anticoagulant therapy in surgical patients.

Methods

Study Objective

This study was conducted as a single-group, pre-test and post-test design, to determine the knowledge levels of nurses about NOACs given before and after surgery and to examine the effect of the training provided on their knowledge levels.

Study Design and Setting

This research was designed as a quasi-experimental study employing a single-group pretest-posttest method. The study was conducted at a 159-bed foundation university hospital in Istanbul, Turkey, between November 2022 and December 2022.

Research Hypothesis

H1: The education provided on NOACs will increase the knowledge levels of nurses.

Population and Sample

The population of this study consisted of 182 nurses working at a 159-bed foundation university hospital in Istanbul. A sample size calculation was conducted using G-Power analysis. The statistical power analysis was based on data obtained from a published study. In cases where the significance level was not specified, an alpha level of $\alpha=0.05$ was assumed for the calculations. The sample size was determined by considering the significance level of the hypothesis and the effect size. Based on the data from the reference study, with an effect size of 0.74, a significance level of $\alpha=0.05$, and a power of $1-\beta=0.80$, the minimum required sample size was determined to be 60 participants to detect a significant difference between measurements (10). During the study

period, taking into account the minimum required sample size, 70 nurses who met the inclusion criteria, were not on leave, consented to participate, and completed the survey forms were included in the sample.

The inclusion criteria required participants to be full-time nurses who voluntarily participated in the study, provided signed informed consent, were proficient in Turkish, and had no neurological, psychological, or communication problems. Participation in the study was entirely voluntary, given the shift-based work system and the high workload in the hospital. Nurses who met the inclusion criteria and provided informed consent were included in the study, while those who did not meet the criteria or chose not to participate were excluded.

Data Collection Instruments

Data were collected using the following tools: Descriptive Information Form: Developed based on a literature review, this form included 16 questions covering sociodemographic characteristics and aspects related to NOACs (11).

NOAC Knowledge Form: This 15-item form was designed to assess the nurses' knowledge regarding NOACs. The form included questions on the names of NOACs, their mechanisms of action, indications, contraindications, excretion pathways, antidotes, usage algorithms, and monitoring requirements. Each question was scored as one point, with a maximum possible score of 15. Higher scores indicated a greater knowledge level regarding NOACs. The form was validated by five experts in nursing education, and the content validity index was found to be 0.99 (12-14).

Administration of Pre-Test Questions on NOAC Knowledge Form

In Istanbul, nurses who met the inclusion criteria and worked at the private hospital, which had granted institutional approval for the study, were invited to participate voluntarily. The educational sessions were organized into 10 sessions, considering the number of participants. The nurses were informed about the study's duration and purpose, and verbal and written consent was obtained from those who agreed to participate. Data collection forms were completed through face-to-face interviews. Prior to the start of the

education sessions, the nurses were informed about the upcoming training, and they were asked to complete the “Personal Information Form” and the “NOAC Knowledge Form” in the training room before the educational content was presented. The duration of the training session was planned to be 45 minutes.

Implementation of the NOAC Nurse Training Program

The training sessions were conducted in the hospital’s training room from December 5 to December 12, 2022, with two sessions held daily during the daytime, each consisting of 10-12 nurses. All topics were presented using a PowerPoint presentation.

NOACs Nurse Training Plan

The table below outlines the training plan provided to nurses regarding NOACs medications (12-14).

Implementation of Post-Test Questions on NOAC Knowledge Form

Two weeks after the training was provided, the post-test “NOAC Knowledge Form” was administered to evaluate the effectiveness of the education. Nurses were given 30 minutes to answer the questionnaire. After collecting the post-test data forms from the nurses, the training process was reviewed, and feedback was gathered from the nurses to conclude the study.

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 22.0. The normality of the data distribution was assessed using the Kolmogorov-Smirnov test. Given the non-parametric distribution of the data, the Wilcoxon Signed-Rank Test was used to compare pretest and posttest scores. The internal consistency of the NOAC Knowledge Form was evaluated using the Kuder-Richardson 20 (KR-20) formula, with a

Training Plan	
Training Title	Nurse Education on NOACs
Duration	45 minutes
Location	Conference room of a private hospital
Objective	To determine the effect of education on nurses’ knowledge levels regarding NOACs medications in the context of preoperative and postoperative care.
Learning Goal	To increase nurses’ knowledge about NOACs in the context of preoperative and postoperative care through provided education.
Materials Used in Training	PowerPoint Presentation
Target Group	All nurses working at the hospital
Evaluation Methods	NOAC Knowledge Form
Introduction	Session opening, Objectives, and Goals of the Training
What Are Anticoagulant Drugs?	Definition of Anticoagulants, Types of Anticoagulants
What Are NOACs?	Types, Indications, Complications, and Contraindications of NOAC
Characteristics of NOAC Drugs	Information on Dabigatran, Rivaroxaban, Apixaban, Edoxaban
Monitoring NOAC Drugs	Comprehensive monitoring and clinical considerations in patients receiving preoperative and postoperative care with the use of Novel Oral Anticoagulants (NOACs), focusing on optimizing therapeutic outcomes and minimizing perioperative risks.
Key Points in Patient Education on NOACs	Dosing algorithms, Daily activities, and Emergency situations for patients using NOACs
Evaluation of Training	Evaluation of the session, sharing thoughts and feedback

resulting reliability coefficient of 0.320, indicating low internal consistency.

Results

The frequency and percentage results obtained from the personal information form used in the study were presented. When examining the personal characteristics of the nurses participating in the study, it was found that the average age of the nurses was 25.8 years, 71.4% were female, 38.6% had a bachelor's degree, and 60.0% had been working in their profession for 1-5 years. Additionally, 22.9% of the nurses worked in a general intensive care unit, 88.6% had been working in their current clinic for 1-5 years, and 88.6% had not received training on NOAC. Furthermore, 98.6% of the nurses reported that they inquire about the medications used, 9.1% provided patients with information about the medications they would use, 64.3% rated the effectiveness of the information given as moderate, and 100% indicated that there was no informational booklet related to oral anticoagulants available in their workplace. The results obtained are presented in Table 2.

When examining the distribution of medication usage among the participating nurses in their respective clinics, it was found that 77.1% used Heparin, 98.6% used Enoxaparin Na, 62.9% used Warfarin, 42.9% used Rivaroxaban, 54.3% used Apixaban, 11.4% used Edoxaban, and 12.9% used Dabigatran. The most commonly used medication in the clinics was Enoxaparin Na at 98.6%, while the least used medication was Edoxaban at 11.4%. The results are presented in Table 3.

This table shows the comparison of the total pre-test and post-test scores for the NOAC Knowledge Form. The significant p-value ($p < 0.001$) indicates a statistically significant improvement in the knowledge levels of the participants following the educational intervention. The results are presented in Table 4.

The table compares various descriptive characteristics of nurses with their mean scores on the NOACs Knowledge Form. The analysis reveals no statistically significant differences in knowledge scores based on educational level ($p = 0.960$) or years of experience ($p = 0.063$). However, a significant difference is observed in

knowledge scores based on the number of years nurses have spent in their current department ($p = 0.018$), with those who have worked for 6-10 years showing higher scores compared to those with 1-5 years of experience. Additionally, there is no significant difference in knowledge scores between nurses who received education on NOACs and those who did not ($p = 0.851$). These findings suggest that while overall experience and education level may not significantly influence knowledge of NOACs, experience in a specific department may enhance familiarity and understanding of these medications. The results are presented in Table 5.

Discussion

The findings of this study confirmed the hypothesis, "H1: Education on NOACs medications increases the knowledge level of nurses." The results demonstrated a significant improvement in the nurses' understanding of NOACs following the educational intervention, indicating that targeted education plays a crucial role in enhancing the knowledge and competencies of nurses in managing these medications effectively in clinical settings.

This study identifies significant gaps in nurses' education and training regarding NOACs, despite their critical role in patient management, particularly in perioperative settings. Most nurses lacked formal training on NOACs, raising concerns about risks such as adverse events and suboptimal outcomes. While nurses actively inquired about medications, confidence in educating patients was notably low, highlighting the need for enhanced educational efforts. These findings align with Baysal et al. and Durusoy, who similarly reported demographic trends of predominantly female, young nurses with substantial clinical experience but limited training on anticoagulants (15,16). The absence of educational resources, such as booklets on oral anticoagulants, underscores the need for institutional support and the integration of NOAC-focused content into pre-service and in-service training. Addressing these gaps through targeted interventions and resource development is essential for improving knowledge, fostering confidence, and ensuring safe and effective medication management in clinical practice, as supported by recent literature (6,17-20).

Table 2. Comparison of the descriptive characteristics of participating nurses (n=70)		
Variables	Number (n)	Percentage (%)
Average age: 25.8±5.2 (min: 21.0 - max: 48.0)		
Gender		
Female	50	71.4
Male	20	28.6
Educational level		
High school	23	32.9
Associate degree	17	24.3
Bachelor's degree	27	38.6
Postgraduate	3	4.3
Years of experience		
1-5 years	42	60.0
6-10 years	16	22.9
Over 11 years	12	17.1
Years working in the current clinic (unit)		
1-5 years	62	88.6
6-10 years	5	7.1
Over 11 years	3	4.3
Received training on NOACs		
No	62	88.6
Yes	8	11.4
Inquire about medications used		
No	1	1.4
Yes	69	98.6
Provide information to patients about medications		
No	2	2.9
Yes	68	97.1
Evaluation of the effectiveness of provided information		
Never	2	2.9
Rarely	31	44.3
Always	37	52.9
Perceived adequacy of knowledge about NOACs		
Inadequate	20	28.6
Moderate	45	64.3
Adequate	5	7.1
Availability of information booklets on NOACs in the Institution		
Yes	0	0.0
No	70	100.0
If yes, does the information booklet include NOACs?		
Yes	0	0.0
No	70	100.0

Table 3. Comparison of medication usage in the clinics of participating nurses (n=70)

Medication	No (n)	%	Yes (n)	%
Heparin usage	16	22.9	54	77.1
Enoxaparin Na usage	1	1.4	69	98.6
Warfarin usage	26	37.1	44	62.9
Rivaroxaban usage	40	57.1	30	42.9
Apixaban usage	32	45.7	38	54.3
Edoxaban usage	62	88.6	8	11.4
Dabigatran usage	61	87.1	9	12.9

Table 4. Comparison of the significance of the difference between the pre-test and post-test total scores of the NOAC Knowledge Form (n:70)

Variables	n	X	SD	df	t*	p**
Study Group Pre-Test	70	4.74	1.87	68	-7.294	p<0.001
Study Group Post-Test		11.51	1.46			

*Wilcoxon Signed-Rank Test – p<0.001 – based on negative ranks.

Table 5. Comparison of descriptive characteristics of nurses and mean scores of NOACs knowledge (n=70)

Characteristics	n	Mean Rank	Statistical Analysis*
Educational level			X ² : 0.289 df: 3 p:0.960
High school	23	35.26	
Associate degree	17	36.35	
Bachelor's degree	27	35.81	
Graduate degree	3	29.67	
Years of experience			X ² : 5.52 df: 2 p:0.063
1-5 years	42	30.98	
6-10 years	16	41.16	
Over 11 years	12	43.79	
Years in the current department			X ² : 7.99 df: 2 p:0.018
1-5 years	62	33.08	
6-10 years	5	54.80	
Over 11 years	3	53.33	
Education on NOACs **			U: 238.0 p: 0.851
No	62	35.66	
Yes	8	34.25	

Kruskal-Wallis H Test; ** Mann-Whitney U Test - Note: Bonferroni correction applied for group differences.

This study highlights a significant gap in patient education, with most nurses inquiring about medications but only a small proportion providing sufficient information to patients. The lack of educational resources, such as informational booklets, further exacerbates this issue, underscoring the need for enhanced training and accessible materials to support nurse-led education. Findings align with Baysal (2018), who demonstrated the effectiveness of nurse-led education in reducing drug-related complications (15). The statistically significant improvement in nurses' knowledge following the educational intervention, as reflected in the post-test scores ($p < 0.001$), emphasizes the impact of structured training programs on enhancing clinical competencies. Consistent with prior research, such as Baysal et al. and studies in Turkey and Europe, in-service training has proven to improve nurses' knowledge and practical skills in anticoagulant management (15,22-26). These results reaffirm the necessity of integrating comprehensive, ongoing education on NOACs and anticoagulant therapies into institutional training programs to optimize patient outcomes and ensure safe medication management.

As the primary caregivers responsible for medication administration and patient education, nurses play a pivotal role in ensuring the safe and effective use of anticoagulants, which are critical in managing thromboembolic risks in surgical patients. Recent literature has increasingly emphasized the need for specialized training in NOACs, recognizing the complexity and potential risks associated with these medications (3,15). Studies have shown that well-informed nursing staff can significantly reduce the incidence of medication-related complications, thus enhancing patient safety and outcomes (5,8). The findings of this study, which demonstrate a significant improvement in nurses' knowledge following an educational intervention, reinforce the necessity of continuous professional development in this area. By aligning with current research that advocates for regular assessment and targeted education of healthcare professionals, this study contributes valuable insights into the effective management of anticoagulant therapy, ultimately supporting better surgical care practices and improved patient outcomes (24,26). These results suggest that integrating comprehensive

anticoagulant education into routine training programs for nurses is essential for maintaining high standards of care in surgical settings.

The findings of this study underscore the complex factors influencing nurses' knowledge of NOACs in clinical practice. While overall years of experience and educational attainment did not significantly impact the knowledge levels of nurses, the duration of experience within a specific department emerged as a key factor. Nurses who had worked in their current department for 6-10 years exhibited significantly higher knowledge scores, suggesting that prolonged exposure to department-specific practices and patient populations enhances familiarity with NOACs. The findings of this study provide important insights into the factors influencing nurses' knowledge of NOACs within clinical practice. Notably, while educational level and overall years of experience did not significantly impact the nurses' knowledge scores, the number of years spent working in their current department emerged as a significant factor. Nurses with 6-10 years of experience in their current department exhibited notably higher knowledge levels compared to those with 1-5 years of experience. This suggests that specific, prolonged exposure to department-related practices and patient populations may enhance familiarity and understanding of NOACs. These results align with the broader literature, which emphasizes the importance of practical, context-specific experience in developing clinical competencies, particularly in specialized areas such as anticoagulation management.

Ferguson et al. (2018) demonstrated that targeted educational interventions, such as mobile health (mHealth) platforms, significantly enhance nurses' knowledge when spaced and context-specific, particularly in atrial fibrillation and anticoagulation management (27). Similarly, Bloie (2014) emphasized the importance of structured educational programs in ensuring up-to-date knowledge in rapidly evolving areas like anticoagulation therapy (28). These findings highlight that continuous education, combined with practical experience, is crucial for developing expertise in managing complex medication and improving patient outcomes. Interestingly, no significant difference in knowledge scores was

found between nurses formally educated on NOACs and those without such training, raising questions about the alignment of educational programs with practical needs. This suggests a potential disconnect between the content of current programs and the challenges faced by nurses in real-world settings (29). Research underscores the importance of department-specific experience and targeted, practical training in enhancing NOAC knowledge, particularly in settings where these medications are frequently used. To optimize outcomes, healthcare institutions should adopt more targeted and context-specific training approaches, integrating practical on-the-job training with formal education. Ensures nurses remain competent in managing anticoagulants, ultimately improving patient care and outcomes. Future research should focus on refining the content and delivery of educational interventions to better address the practical needs of nursing staff (30,31).

Conclusion

This study demonstrated that the targeted educational intervention led to a statistically significant improvement in nurses' knowledge levels regarding the management of Novel Oral Anticoagulants (NOACs). Given the critical role of NOACs in preoperative and postoperative care, it is essential that future educational programs address the specific challenges and gaps identified in this study. Emphasis should be placed on enhancing nurses' understanding of NOAC pharmacology, perioperative management protocols, and strategies to mitigate associated risks. By equipping nurses with the necessary knowledge and skills, these initiatives can significantly contribute to improving patient safety and optimizing outcomes in anticoagulation therapy, particularly in surgical settings where precise management of NOACs is crucial for reducing perioperative complications.

Limitations

The fact that the research was conducted in a single institution limits its generalizability. This study was conducted with the participation of 70 individuals from a total population of 182. However, as the sampling method was based on voluntary participation rather than a systematic selection process, there exists the potential

for non-response bias. The perspectives and responses of individuals who did not participate might have had an impact on the findings, either positively or negatively. This limitation should be taken into consideration when interpreting the results, as it may influence the overall generalizability and robustness of the study.

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Researchers' Contribution Rate Statement:

Concept/Design: GK, TSG

Analysis/Interpretation: GK, TSG

Data Collection: TSG

Critical Review: GK, TSG

Approver; GK, TSG

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