OPTIMIZATION AND MONITORING OF ANTICOAGULANT DRUG USE INA TERTIARY CARE HOSPITAL

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ABSTRACT

Background:
Anticoagulants are essential in preventing thromboembolic events such as stroke, DVT, pulmonary embolism, and cardiac complications. Despite their benefits, inappropriate use can lead to serious adverse outcomes, necessitating close monitoring and effective counseling by clinical pharmacists.

Aim and Objectives:
To optimize and monitor anticoagulant drug use in a tertiary care hospital.

Methodology:
A prospective observational study was conducted in cardiology, neurology, and general medicine departments. Patients prescribed anticoagulants were enrolled after informed consent. Data on demographics, clinical details, and knowledge of oral anticoagulants were collected. Interventions included detection of medication errors, drug interactions, and adverse reactions, with dose adjustments guided by International Normalized Ratio (INR). Patients also received education through information leaflets.

Results:
Among 137 patients, most were aged 51–70 years (43.79%) and male. Enoxaparin (40.87%) was the most prescribed parenteral anticoagulant, while Warfarin (24.04%) was the leading oral drug. Cardiac diseases were the primary indication (57.66%) and comorbidity (29.92%). Significant associations were observed between departments and drug choice (p=0.000),

indications and medications (p=0.003), and indications and comorbidities (p=0.000). INR was within therapeutic range in 80% of patients. Identified drug interactions, errors, and ADRs were addressed and accepted by physicians. Most patients had moderate knowledge of anticoagulants.

Conclusion:
Clinical pharmacist interventions improved anticoagulant optimization, INR control, and patient safety, underscoring their key role in enhancing therapeutic outcomes.

KEYWORDS: Anticoagulant, bleeding complication, OAC, DOAC

INTRODUCTION

Anticoagulants are drugs that prevent blood from clotting by inhibiting the synthesis or activity of clotting factors. They are widely prescribed to reduce the risk of thromboembolic events such as stroke, deep vein thrombosis (DVT), pulmonary embolism (PE), and cardiac complications. By preventing clot formation or extension, anticoagulants are central to thrombosis prevention and treatment. However, their clinical use is complex and associated with adverse drug events and increased hospital readmissions. Subtherapeutic levels raise the risk of thromboembolism, while supratherapeutic levels increase bleeding risk, making careful monitoring and patient counseling essential (1–3). Anticoagulants are most often used for conditions such as atrial fibrillation, venous thromboembolism, and ischemic stroke prevention. Venous thromboembolism remains a major global health concern, with an incidence of 115–269 and a mortality of 9–32 per 100,000 population, while atrial fibrillation affects more than 33 million people worldwide and continues to rise (5). Oral anticoagulants (OACs) remain the cornerstone of long-term therapy and are broadly categorized into vitamin K antagonists (VKAs) such as warfarin and acenocoumarol, and direct oral anticoagulants (DOACs) including dabigatran, apixaban, rivaroxaban, and edoxaban. VKAs have been in clinical use for decades and are effective, but they require regular INR monitoring and are subject to multiple food and drug interactions. DOACs, introduced in 2010, offer advantages such as fewer interactions, predictable dosing, and reduced bleeding risk, but their high cost and limited physician familiarity have slowed their universal adoption (5,6). Warfarin remains widely prescribed, though its narrow therapeutic window, need for frequent monitoring, and interaction profile complicate management (7). Lifelong anticoagulation is often necessary, particularly for patients with mechanical heart valves, but excess dosing can reduce quality of life and increase morbidity and mortality (8). Alongside oral agents, parenteral anticoagulants such as unfractionated heparin, low-molecular-weight heparins (LMWHs), and fondaparinux are extensively used in the treatment and prophylaxis of thromboembolic disorders. These agents are effective but carry bleeding risks that vary with dose intensity, comedications, and patient factors, with incidence ranging from 0 to 7% for unfractionated heparins and 0 to 3% for LMWHs (9,10).

The complexity of anticoagulant management highlights the importance of pharmacists in therapy optimization. Pharmacists provide essential contributions in counseling, monitoring

therapy, preventing adverse interactions, and supporting physicians in dose adjustment. In several Western countries, pharmacist-managed anticoagulation clinics have demonstrated improved INR control, reduced adverse events, and better patient adherence compared to traditional care models (12). In developing countries such as India, the need for such services is equally critical, given the increasing use of anticoagulants and the higher risk of drug-related problems and poor compliance (3). Anticoagulation clinics, whether independent or part of larger thrombosis centers, play an important role in overseeing patients on therapy, offering both clinical and laboratory expertise. Models such as patient self-management, standardized monitoring, and pharmacist-led services consistently improve safety and outcomes compared to physician-only management (12).

Anticoagulants are high-risk but indispensable drugs, and errors in their use can result in significant harm. Patient education, healthcare provider awareness, and systematic monitoring remain central to minimizing complications. Both VKAs and DOACs require careful selection and follow-up, and as their use continues to expand, integrating pharmacists and structured anticoagulation services into care systems is crucial to improving therapeutic outcomes and ensuring patient safety (11,13).

METHODOLOGY

The study was conducted at KIMS AI-Shifa super specialty hospital which is a 350 bedded hospital situated at Perinthalmanna at Malappuram district of Kerala.

The prospective observational study was carried out for over a period of one year commencing from June 2022 to June 2023 among inpatient and outpatient of major departments like General medicine, Cardiology, Neurology.

This study was approved by the ethical committee of the institution and the consent was obtained officially in order to start the study. It was certified by the institutional ethics committee and approved the proposal of the study as per letter no: **KAS:ADM: IEC: 0177B:22**

All patients were included in this study based on the inclusion and exclusion criteria. The study includes individuals prescribed anticoagulant medication, both as outpatients and inpatients, within the departments of cardiology, neurology, and general medicine. Eligible participants are 18 years or older, of any gender. Excluded are pregnant women, patients with psychiatric conditions, those with visual or hearing impairments, impaired cognition, and intubated individuals.

This prospective observational study was conducted among inpatients and outpatients in the Cardiology, Neurology, and General Medicine departments, encompassing various phases. Phase I involved obtaining ethical committee clearance, selecting patients prescribed anticoagulant drugs based on specific criteria, and collecting data using a structured form detailing demographics, medical history, lab investigations, and prescriptions. Phase II assessed patient files, optimized anticoagulant treatment, monitored INR levels, adverse effects, medication errors, and drug interactions were analyzed and managed. Phase III included a questionnaire to gauge patients' knowledge about oral anticoagulants, categorizing their knowledge levels. Patients with poor knowledge were followed up. Phase IV encompassed comprehensive monitoring, proper anticoagulant dosing, providing patient information leaflets, issuing anticoagulant alert cards, and documenting all interventions.

RESULTS

The 51-70 age group had the most patients (60), making up 43.79% of the total. The above 70 age group had 48 patients, comprising 35.04%. The 18-30 age group had the fewest patients (5), accounting for 3.65%, while the 31-50 age group had 24 patients, making up 17.52%. Among participants, 59.12% (n=81) were males, and 40.87% (n=56) were females, showing a male predominance.The study looked at three departments: cardiology, neurology, and general medicine. Cardiology and neurology had the most patients. Cardiology had 43.2% males and 51.7% females (total 46.7%). Neurology had 46.9% males and 30.3% females (total 40.16%). General medicine had the fewest patients: 9.8% males and 17.8% females (total 13.1%). Overall, cardiology had the most patients.

Out of the 137 patients, about 43% used oral anticoagulants (OACs), while 57% used parenteral anticoagulants. Most patients preferred parenteral anticoagulants. In the hospital, they use injectable (Heparin, Enoxaparin) and oral (Warfarin, DOACs) anticoagulants.

Among 137 patients in the study, injectable anticoagulants were more common. Enoxaparin was prescribed to 41%, Heparin to 15%. For oral anticoagulants, Warfarin was preferred (24%), followed by Acenocoumarol (12%), Rivaroxaban (2%), and Apixaban (1%). Some patients used both types. Overall, Enoxaparin and Warfarin were the most prescribed anticoagulants.

The chi-square test (statistic: 118.7, p-value: .000) indicates a significant association between department and most prescribed anticoagulant. This suggests varying preferences among departments for anticoagulant choices.

Indications were grouped into heart diseases, blood-related diseases, and cerebrovascular accidents (CVA). Heart diseases encompassed coronary issues, rheumatic heart disease, valve replacements, etc. Blood-related diseases covered embolism, thrombosis, and CVA included stroke varieties. Most common was heart diseases (57.66%), followed by CVA (35.76%) and blood-related diseases (6.56%).

The Spearman's Rho test revealed a correlation coefficient of -0.24415 with a p-value of 0.003, providing robust evidence of a noteworthy and significant association between indications and the drugs used for patients in the study.

ich Cardiac diseases were most common (29.92%), followed by hemiparesis (28.4%). Blood-related diseases appeared in 5.10%, thalamic infarction in 2.1%, and other conditions in 10.94% (15 patients). No comorbidities were present in 23.35% (32 patients).

The chi-square test (statistic: 1.800E2, p-value: .000) indicates a significant association between anticoagulant indication and comorbid condition. Strong evidence supports this relationship.

59 patients were taking OAC and all those patients were undergone INR test. In case of parenteral anticoagulant only 23 patients were undergone INR test and 55 were not undergone INR test.The greater number of patients had their INR at therapeutic range 82% (n=47). But 6 patients (10.2%) their INR is below therapeutic value and 4 patients (7.01%) had their INR above therapeutic value

Out of 137 patients only 3 patients occur side effect due to anticoagulant. Gastrointestinal bleeding, epistaxis, hematemesis are commonly seen side effects in these patients.30 patients

(21.9%) had the medication error. In those data the following medication errors are occurs like prescribing errors, drug administration errors.

The pharmacist intervention on medication error shows 93.3 % (28 medication error) were accepted by the physician. And only 6.67% (2 medication error) were not accepted by the physician. Nearly 50% (68 patients) drug interaction occurred from 137 data.in that category -D and category -X interactions occurs. 44.52% were category -D interactions (61 patients) and only 5.10% were category-X (7 patients)

From 68 drug interactions only 43% were accepted by the physicians. And 57% interactions were not accepted by the physicians. All category-x interactions were accepted by the physicians. But some category -D interactions not accepted by the physician. Among the 137 cases, only 2 (1.45%) experienced adverse drug reactions (ADRs). One ADR was Rivaroxaban-induced coagulopathy in a 42-year-old female, assessed as "probable" on the Naranjo scale. The other was gum bleeding due to injection enoxaparin in a 52-year-old female, with "severity" assessed on the Naranjo scale.

From all the 137 patients only 4 patients (2.91%) are taking OTC / herbal medicines. Remaining all are not taking any other OTC/herbal medicines.Among 137 patients, 59 were prescribed OAC drugs. Knowledge assessment via questionnaire revealed 8 patients (13.55%) had poor knowledge, 27 (45.7%) had average knowledge, and 24 (40.6%) had good knowledge.

DISCUSSIONS

The study at KIMS AL SHIFA hospital aimed to improve and oversee anticoagulant medication usage in General Medicine, Neurology, and Cardiology patients. The study, lasting one year, observed 137 patients meeting specific criteria.

In this study, among the 137 patients, those aged 51-70 years had a higher usage of anticoagulants (43.79%) compared to other age groups. This aligns with similar findings from previous studies by Jodi-Ann Mckenzie et.al [(14)]. However, this contrasts with the study by Lamis R. Karaoui et.al [(15),] which found greater anticoagulant usage among individuals under 50 years old.

The study found more male patients (46.43%) compared to females due to increased male consultations. A study by Itthidet Kamthornthanakarn et.al. [(8)] reported higher female numbers. This study focused on three departments, with the majority of patients (46.7%, n=64) coming from the cardiology department. The neurology department accounted for 40.16% (n=55) of patients, while the general medicine department constituted 13.1% (n=18) of the participants.

Among the 137 patients in the study, 57% were prescribed parenteral anticoagulants, while 43% received oral anticoagulants. In the hospital, injectable anticoagulants like Inj. Heparin and Inj. Enoxaparin are commonly used, along with oral anticoagulants including Vitamin K antagonists (VKA) like Warfarin and Acenocoumarol, and Direct Oral Anticoagulants (DOAC) like Rivaroxaban and Apixaban.

Among the patients, Inj. Enoxaparin was the most prescribed parenteral anticoagulant (40.87%), and Warfarin was the most prescribed oral anticoagulant (24.04%). The use of Warfarin aligns with its reputation for safety and treatability using Vitamin K. This finding supports a previous study by Jennifer Cai et.al [(16)].

Comparing departments and the most prescribed anticoagulant, a significant association was observed (p-value < 0.05). This suggests that certain anticoagulants are more common in different departments, consistent with the departments' specialties. This differs from a study by Prabhat Singh et.al [17], where Nicoumalone was more prescribed than Warfarin.

In summary, the study highlights varying anticoagulant usage across departments, with parenteral anticoagulants and Warfarin being commonly prescribed, corroborating earlier research.

The study categorized indications into three groups: heart diseases, blood-related conditions, and cerebrovascular accidents (CVA). Most anticoagulant use was for heart diseases (57.66%), followed by CVA (35.76%) and blood-related diseases (6.56%). These trends are consistent with treatment guidelines and a prior study by R. Lakshmi [3].

An examination of indications and administered medications revealed a significant association (Spearman's Rho -0.24415, p-value = 0.003), indicating a meaningful correlation between these factors.

Among 137 patients, the leading comorbidity was cardiac disease (29.92%), followed by hemiparesis (28.4%), blood-related conditions (5.10%), thalamic infarction (2.1%), and other conditions (10.94%). Around 23.35% (32 patients) had no comorbidities. Unlike a study by Anila K. N. et al. (18)which found hypertension as the most common comorbidity, our findings differ.

The analysis of anticoagulant indications and comorbid conditions resulted in a p-value of 0.000, indicating a significant association ($p < 0.05$). This supports a meaningful link between these variables.

Out of 137 patients, 59 taking oral anticoagulants (OAC) underwent INR tests. Among 59 patients on parenteral anticoagulants, only 23 underwent INR tests, leaving 57 without testing. While INR is vital for adjusting OAC doses, it's also crucial for parenteral anticoagulants to prevent complications. Thus, INR monitoring should be applied to both types of anticoagulants.

Among patients taking OAC drugs, 80% (n=47) had their INR within the therapeutic range, while 17% (n=10) were below and 3% (n=2) were above the therapeutic value. Dose adjustments were made based on these INR levels. For those outside the therapeutic range, dose adjustments were reported to the physician and patients were monitored accordingly. Treatment followed established guidelines, akin to studies by Prabhat Singh et.al (17)Teferi Gedif Fenta [19]

Out of 137 patients, 3 experienced anticoagulant side effects like epistaxis, hematemesis, GI bleeding. Informed to the physician about observed side effects, and advised to discontinuing the medication. 21.9% (n=30) encountered medication errors; 93.3% (28) were accepted and rectified. Study aligns with Abdulrhman Alrowily et.al . [20]

Among 137 patients, around 50% (68) experienced drug interactions, primarily in categories -D and -X. Category -D interactions accounted for 44.52% (61 patients), while category -X interactions were 5.10% (7 patients). Physicians accepted only 43% of these interactions, with 57% involving antiplatelet and anticoagulant combinations, which were not accepted due to regular monitoring. All category -X interactions were accepted. Category -D interactions were assessed using the LEXICOMP drug interaction checker.

In this study, only 2 cases (1.45%) of adverse drug reactions (ADRs) were observed. One ADR involved rivaroxaban-induced coagulopathy in a 42-year-old female, assessed as probable on

the Naranjo scale. Another ADR was gum bleeding induced by injection enoxaparin in a 52-year-old female, with a severity assessment on the Naranjo scale. Immediate drug cessation and preventive measures stabilized both patients' conditions. This study contrasts with Sahithi Sharma et.al. [9] findings, where Fondaparinux and Unfractionated Heparin were associated with ADRs.

Among 137 patients, 4 were using herbal or OTC drugs in conjunction with OAC medications. This combination increases the bleeding risk due to enhanced anticoagulation effects. Excessive bleeding from minor injuries or spontaneous bleeding can result. To ensure safe usage, consulting a healthcare professional is crucial. This study aligns with R. Lakshmi et.al [3] research.

Out of 59 patients on OAC drugs, knowledge assessment was conducted using a standard questionnaire. Results showed 8 patients (13.55%) with poor knowledge, 27 (45.7%) with average knowledge, and 24 (40.6%) with good knowledge. Poor knowledge mainly included newcomers to OACs and some using DOACs. Proper counseling and information leaflets were provided, alongside follow-ups and INR assessments. This supports findings in studies by Fikret Vehbi izzettin et.al.[21] and R. Lakshmi et.al. [3]. Enhancing patient knowledge is vital for improved OAC treatment outcomes, underscoring the importance of routine assessments in this patient group.

The main strength of the study is which effectively optimized anticoagulant treatment through close monitoring, rectifying complications, and enhancing patient knowledge via counseling and information materials.

This study has some limitations. It did not include a comparator group, which limits our ability to draw more authentic conclusion. This study did not incorporate all the outpatient from the three department. During knowledge assessment, often patient’s caregivers were interviewed since it was unable to get responses directly from the patients

CONCLUSION

Based on a prospective study, optimizing and monitoring anticoagulant use in hospitals positively affects therapy. Pharmacists play a key role by counseling patients, preventing interactions, and enhancing INR control. Their interventions improve patient knowledge, safety, and outcomes, urging hospitals to establish pharmacist-driven anticoagulation services for better patient care.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FINANCIAL SUPPORT

I declare that this work has been completed without any financial support.

ETHICS STATEMENT

The study design and protocol have been approved by institutional review board of hospital, perinthalmanna were this study was carried out. It was approved the proposal of the study as per letter no: **KAS:ADM: IEC: 0177B:22**

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