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Impact of geriatric assessment on the prescription of direct oral anticoagulants: Cohort study

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Abstract

Prescribing DOACs (Direct Oral Anticoagulants) in the elderly must consider the frailty of this population as well as the multiple associated physiological changes. In this context, Geriatric Assessment (GA) remains an essential tool allowing multidimensional evaluation of their nutritional, cognitive, psychological, and social status.

Objective: To assess the impact of GA on the prescription of DOACs in the Internal Medicine and Cardiology departments of HMIMV.

Methods: We report an observational, prospective, single-center cohort study conducted on a series of 30 patients on DOACs, who underwent a comprehensive and multidisciplinary assessment through a questionnaire to highlight the impact of GA on DOAC prescription.

Results: The average age of our patients was 80 years. All patients presented associated comorbidities: hypertension, dyslipidemia, heart failure, and diabetes. 27% of our patients had a significant risk of falls compared to 30% with moderate risk. Half of our series showed cognitive decline. Polypharmacy was common, with 37% of patients on at least 4 medications. Additionally, 57% of our patients had poor nutritional status. Finally, in terms of renal function evaluation, 15 of our patients had moderate renal insufficiency.

Conclusion: Our work highlighted the importance of GA in the management of elderly patients on DOACs. Practically, physicians can optimize the safety and effectiveness of anticoagulant therapy in the elderly while addressing their healthcare needs.

Keywords: Direct Oral Anticoagulants; Standardized Geriatric Assessment; Geriatrics; Comorbidities; Geriatric Evaluation Tests

1. Introduction

Aging is an irreversible physiological process that, over time, transitions an individual from a healthy adult state to one of frailty, marked by a decline in functional capacities across multiple physiological systems, increasing vulnerability to various chronic diseases.

Population aging has become an undeniable global phenomenon, significantly impacting public health and contemporary medical practices. In Morocco, life expectancy at birth has increased by approximately 32 years, rising

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from 42.9 years in 1950–1955 to 77.6 years in 2015 (1). While this progress is a positive development, it is accompanied by significant challenges for the healthcare system, particularly the rising prevalence of chronic diseases such as atrial fibrillation (AF) and venous thromboembolism (VTE), which are strongly associated with advanced age.

As a result, anticoagulant therapy particularly direct oral anticoagulants has become a common practice for preventing thromboembolic complications. However, prescribing DOACs in the elderly cannot be approached in isolation. It must consider the inherent frailty of this population and the numerous physiological changes associated with aging.

In this context, comprehensive geriatric assessment emerges as an essential tool, enabling a multidimensional evaluation that takes into account functional, nutritional, cognitive, psychological, and social aspects of elderly patients.

Our study aimed to explore the impact of geriatric assessment in DOAC prescription for elderly patients, highlighting the importance of considering frailty in therapeutic decision-making and emphasizing the potential benefits of CGA in optimizing anticoagulant treatment in this population.

2. Materials and methods

The objective of this study is to assess the impact of geriatric evaluation on the prescription of DOACs in the Internal Medicine and Cardiology departments of the Mohamed V Military Teaching Hospital (HMIMV).

The secondary objectives include describing the epidemiological and etiological profile of DOAC prescriptions among the geriatric population at HMIMV and highlighting the role of geriatric assessment tests in optimizing patient management.

This is a prospective, observational, monocentric cohort study conducted on 30 patients receiving DOAC therapy in the Internal Medicine and Cardiology departments of HMIMV-Rabat over a 6-month period (from October 2023 to March 2024).

2.1. Patients included in this study were

- Aged 65 years or older, eligible and consenting to participate.
- Hospitalized or seen in outpatient consultations at HMIMV's Cardiology and Internal Medicine departments.
- Receiving DOAC therapy as part of their long-term treatment or upon hospital discharge, regardless of sex.

2.1.1. Exclusion criteria included

- Age strictly under 65 years.
- Refusal to participate in the study.
- Incomplete data, particularly missing questionnaire responses.
- Patients receiving other types of anticoagulants.

A questionnaire was designed to holistically and multidisciplinary assess patients based on the 5 Cs rule

- Co-medication
- Cognition
- Cachexia
- Cockcroft and Gault formula
- Risk of Falls

This aimed to emphasize the impact of geriatric evaluation on DOAC prescription. The questionnaire was structured as follows

2.2. Patient Characteristics

- Age, sex, weight, comorbidities, medical history (e.g., hypertension, atrial fibrillation, stroke, heart failure).
- Indication for anticoagulation, CHA2DS2-VA score, presence of co-medications, and biological values (most recent at the time of anticoagulation initiation or latest for follow-up).
- Renal function assessment using the Cockcroft and Gault formula.

2.3. Geriatric Evaluation Tests and Scales:

Fall Risk Assessment: To identify risk factors for falls, evaluate consequences, and preventive measures, we used the Timed Up and Go Test (TUGT). This is the timed version of the Get Up and Go Test (34).

→Scoring

- ✅ < 20 seconds: Negative test → No or low fall risk
- ⚠ 20-30 seconds: Positive test → Moderate fall risk
- ❗ > 30 seconds: Positive test → High fall risk

2.3.1. Cognitive Status Assessment (Appendix)

The detection and monitoring of dementia in elderly patients rely on specific tests. For our evaluation, we initially conducted

2.3.2. Clock Drawing Test (Appendix) (35):

Patients were given a pre-drawn clock and asked to complete the numbers and set the hands to "quarter to eleven."

Scoring (1 point per criterion, total of 7 points)

- Are the numbers 1 to 12 present?
- Are the numbers in the correct order?
- Are the numbers properly positioned?
- Are both clock hands drawn?
- Is the hour hand correctly positioned?
- Is the minute hand correctly positioned?
- Is the difference in hand size accurate?

Multiple errors may indicate cognitive decline, requiring further assessment.

2.3.3. Mini-Mental State Examination (MMSE)

- Initially developed by Folstein et al. in 1975, with a standardized version by the GRECO research group in 1999 (37).
- Evaluates 30 cognitive functions, including
    - Orientation
    - Memory
    - Attention
    - Language
    - Visuospatial and constructive praxis

2.3.4. Moroccan Adaptation (MMSE-ma)

- Developed in 2003 by a team of Moroccan neurologists
- Validated in 2023 for assessing patients with cognitive impairment and Alzheimer's disease (38).

2.3.5. Interpretation of scores

- ✅ ≥ 27: Normal cognitive function
- ⚠ 24-26: Mild cognitive impairment
- ❗ < 24: Possible dementia

2.3.6. Nutritional Assessment (MNA)

- Developed through an international collaboration in 1999 involving
- Toulouse University Hospital (France)
- University of New Mexico (USA)
- Nestlé Research Center (Switzerland)

- Evaluation components
  - Anthropometric measurements (age, height, weight loss, BMI, arm and calf circumference)
  - Global assessment (lifestyle, medication use, mobility)
  - Dietary evaluation (meal frequency, food and fluid intake, feeding autonomy)
  - Self-perception of health and nutrition
  - MNA Score Interpretation:
    - ✅ > 24: Normal nutritional status
    - ⚠ 17-23.5: Risk of malnutrition
    - ❗ < 17: Malnutrition

2.3.7. Renal Function Assessment (Cockcroft and Gault Formula)

- Essential before prescribing anticoagulants, as renal function determines drug selection and dosage.
- Endorsed by Dabigatran monograph (2012) (41) for monitoring renal function in elderly patients.

- Formula requires only
  - Serum creatinine
  - Weight
  - Age
  - Sex

- Interpretation of results
  - 60 mL/min: No or mild renal impairment
  - 30–60 mL/min: Moderate renal impairment
  - < 30 mL/min: Severe renal impairment
  - < 15 mL/min: End-stage renal disease

Data recorded in Excel and analyzed using Jamovi software for statistical interpretation. Data collection followed ethical principles, ensuring: Confidentiality, Anonymity, Informed consent Findings were presented with scientific integrity and transparency.

3. Results

3.1. Patient Profile

- Median age: 80 years (70.5; 83.8)
- Youngest patient: 66 years
- Oldest patient: 91 years

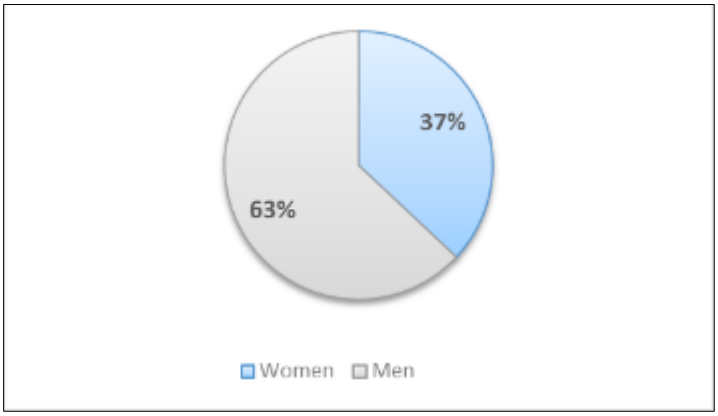

Figure 1 Distribution of patients by sex

Among the patients in our study, 19 were male (63.3%), while females accounted for 36.7%. This results in a male-to-female sex ratio (M/F) of 1.

3.2. Medical history

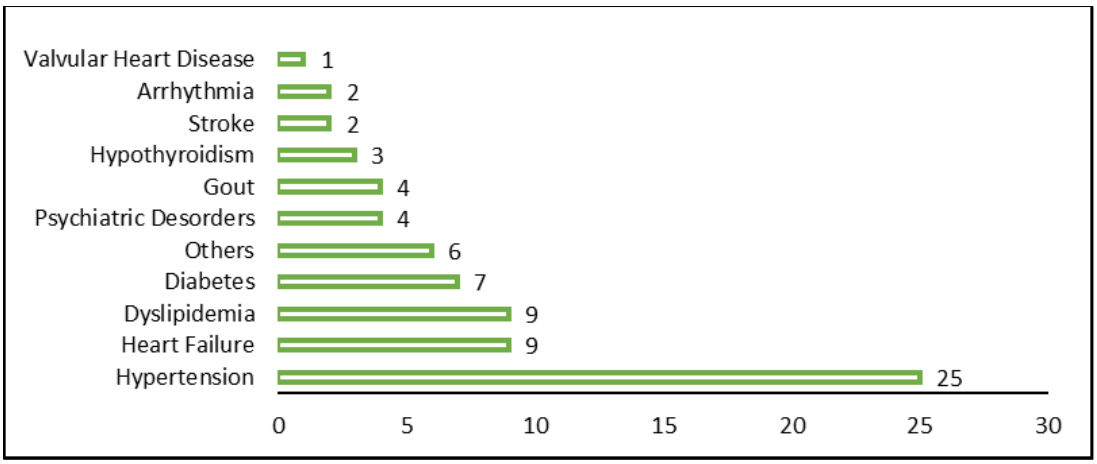

Figure 2 Medical history of patients

3.2.1. Comorbidities

- All our patients had associated comorbidities, with hypertension being the most prevalent (83%).
- Additionally, dyslipidemia and heart failure were each reported in 30% of cases, while diabetes was present in 23% of patients.

3.2.2. Cardiovascular Risk Factors

- All patients exhibited cardiovascular risk factors, with an average of three risk factors per patient, ranging between two and six.
- The most predominant factors were age and sex.

3.2.3. CHA_2DS_2-VASc Score

- The mean CHA_2DS_2-VASc score in our cohort was 4, with a range of 2 to 6.
- Thus, all patients had an indication for anticoagulation therapy.

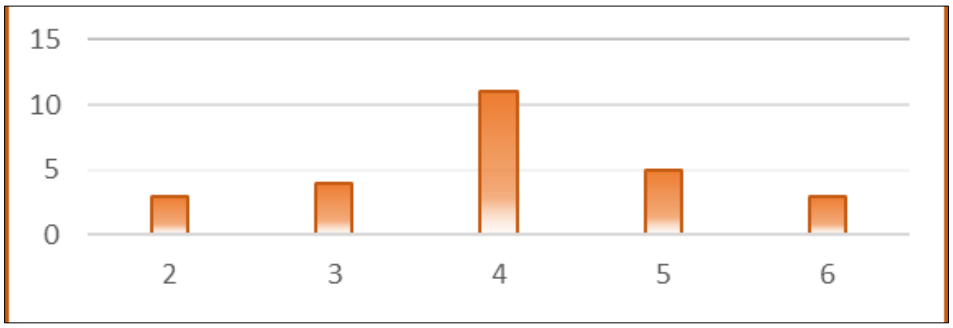

Figure 3 Distribution according to the CHA_2DS_2-VASc score

3.3. Role of *DOACs*

3.3.1. Molecules

Table 1 Distribution of direct oral anticoagulant (DOAC) molecules among patients

Molecules	Brand Name	Number of patients	Dosage	Number of patients
Rivaroxaban	Rexaban®	13	20 mg	11
			15 mg	02
	Xarelto®	06	20 mg	05
			15 mg	01
Apixaban	Eliquis®	11	5 mg	07
			2.5 mg	04

- 63% of our patients were on Rivaroxaban (Rexaban, Xarelto).
- 37% of our patients were on Apixaban (Eliquis).
- None of our patients were receiving anticoagulation with Dabigatran.

3.3.2. Indications

Table 2 The curative and prophylactic indications according to patients

Role of DOACs	Number of patients	Indications	Number of patients
Curative	04	DVT	02
		PE	02
Prophylactic	26	AF	25
		AF + Ischemic Stroke	01

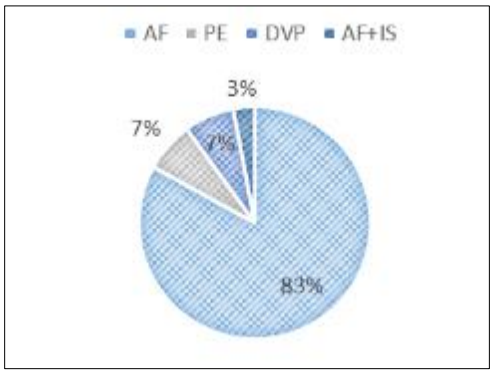

Figure 4 Indications of anticoagulation

3.3.3. Efficacy

- 87% of our patients were on prophylactic anticoagulation with DOACs for atrial fibrillation as the major indication.
- 13% had a curative indication due to either pulmonary embolism or deep vein thrombosis.
- 100% therapeutic efficacy was observed in all patients treated with DOACs, with no thromboembolic events reported during the treatment.

3.3.4. Tolerance

- Only 1 patient (3%) presented with a direct side effect related to direct oral anticoagulants, specifically macroscopic hematuria.
- In 97% of the cases, no adverse or secondary effects related to DOACs were reported.

3.4. Geriatric Evaluation

3.4.1. Co-medication

Our patients were treated with several therapeutic classes due to the associated comorbidities

- Antihypertensive: 60% on beta-blockers, 40% on ARA2.
- Hypolipidemics: 40% on statins.
- Ant diabetics: 23% on oral ant diabetic agents (e.g., Metformin).
    - No drug interactions were reported in our series.
    - Polypharmacy was common among all patients, with an average of 4 medications, and the range varied from 2 to 7 medications.
    - 47% of our patients were taking at least 4 medications.

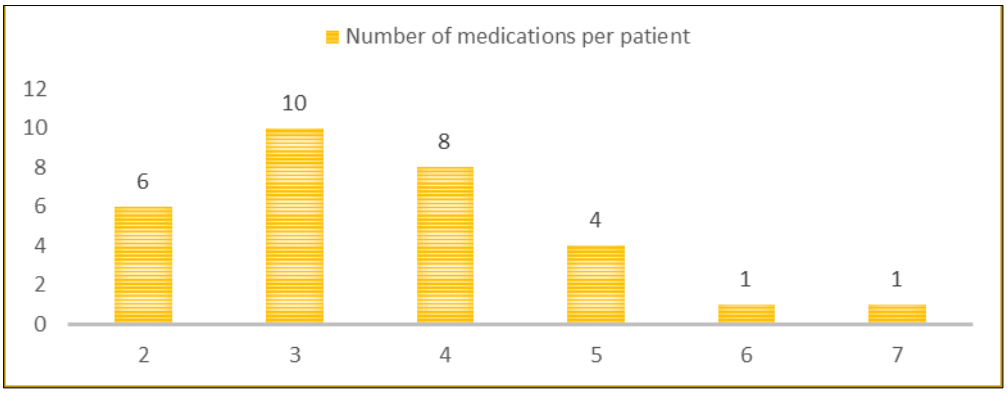

Figure 5 Distribution of patients according to number of medications

3.4.2. Risk of Falling

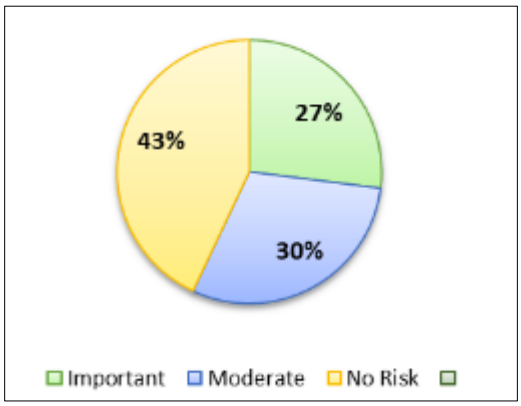

Figure 6 Risk of Falling

Timed Up and Go Test (TUG)

- 27% of patients were classified as high risk for falls.
- 30% had a moderate fall risk.
- 43% had no risk of falls.

3.5. MNA (Mini Nutritional Assessment)

- The nutritional status of our patients was evaluated using the MNA test.
- The median score of our series was 21.8 [19.1; 24.9], with a range from 12 to 28.
- Based on the MNA score, the patients were classified into the following categories:
  - 37% (11 patients) had poor nutritional status.
  - 57% (17 patients) were at risk of malnutrition.
  - 6% (2 patients) had a normal nutritional profile.

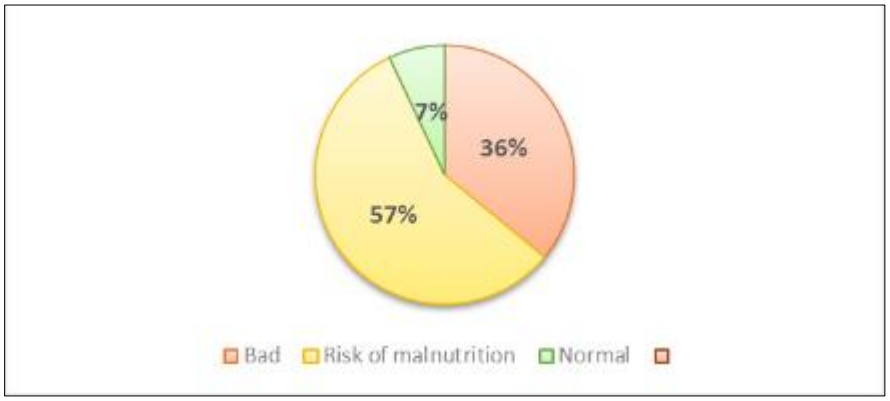

Figure 7 Distribution of patients according to MNA score

3.6. Renal Function

- The renal clearance was assessed using the Cockcroft and Gault formula.
- The median value of our series was 57.8 ml/min/1.73m^2 [44; 89.8], with a range from 28.7 to 114.
- None of our patients had end-stage renal failure.
- One patient had severe renal insufficiency, and 15 patients had moderate renal insufficiency.

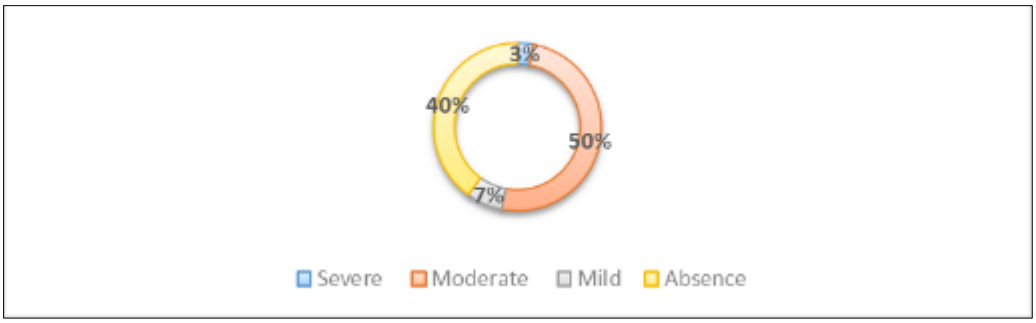

Figure 8 Distribution of patients according to evaluation of the Renal Function

3.7. Clock Test

The Clock Test helps assess multiple cognitive functions. All our patients scored below 7, indicating a potential cognitive decline, suggesting the need for further evaluation through the MMSE.

3.8. MMSE-ma

- The average MMSE score in our series was 21.5, with a range between 12 and 28.
- Based on this score, patients were categorized as follows:
  - 15 patients (50%) with a possible risk of dementia.
  - 4 patients (13%) with mild cognitive impairment.
  - 11 patients (37%) showed normal cognitive function

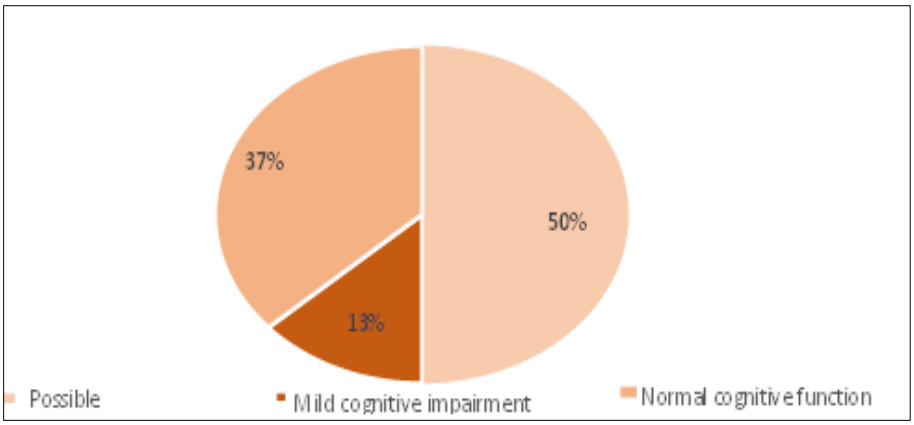

Figure 9 Distribution of patients according to MMSE score

4. Discussion

The Standardized Geriatric Assessment plays a crucial role in the comprehensive management of patients, taking into account their medical, functional, social, and psychological needs. It is of particular importance for elderly individuals on direct oral anticoagulants, as it enables the identification and effective management of complications risk.

The interest of our study was focused on developing a practical, less time-consuming evaluation that primarily studies the key criteria that may influence this medication prescription. This is a geriatric assessment based on the rule of 5 Cs: the risk of Falls, Cognition, Co-medication, Cachexia, as well as the Cockcroft and Gault formula.

4.1. Patient Profile

4.1.1. Age

Age is a risk factor for Venous Thromboembolism (VTE), Ischemic Stroke (IS), and major bleeding in frail individuals. In our cohort, the average age was 80 years. Various studies (ROCKET-AF (42), ARISTOTLE (43), ENGAGE TIMI-AF 48 (44), EINSTEIN (45), RE-LY (46)) have demonstrated the relative benefits of DOACs in elderly subjects, by reducing the bleeding risk compared to Warfarin.

4.1.2. Sex

In our study, 63.3% of patients were men, and 36.7% were women, resulting in a sex ratio of 1.7. The results of the COMBINE-AF (47) study did not show significant interactions between sex and the risk of major bleeding. The male predominance in our study was obtained randomly without any pre-selection.

4.1.3. Comorbidities

Hypertension was the most common comorbidity among our patients, followed by dyslipidemia, heart failure in 30% of cases, and 23% were diabetic. Our results are consistent with those of the studies by Fushimi et al. (48) and PREFER-FA (49).

4.1.4. CHA2DS2-VASC Score

The CHA2DS2-VASC score is fundamental for thromboembolic prevention in atrial fibrillation (AF), and the average score in our cohort was 4. Our results align with those of the study by Fushimi et al. (48), which shows a broad prevalence of anticoagulation. However, it is always essential to remind that anticoagulants should be prescribed based on their benefit-risk ratio, while assessing thromboembolic and hemorrhagic risks. The CHA2DS2-VASC score remains a simple and reliable tool in guiding antithrombotic therapy strategies.

4.2. Geriatric Assessment According to the 5 Cs Rule

4.2.1. Falls and Risk of Falls

Falls are a major health issue in the elderly, often leading to dependency and mortality. Fall-prone patients exhibit risk factors such as walking and balance disorders, sarcopenia, and muscle strength and power reduction. A fall should not

automatically lead to the discontinuation or non-prescription of an oral anticoagulant but should prompt an etiological evaluation to provide a multifactorial management and prevent recurrence. The fall risk should be systematically assessed by the EGS. Physicians should repeatedly inquire about patients' fall history, balance or walking difficulties, and perform brief tests such as the Timed Up and Go Test.

In our study, using the Timed Up and Go Test, 27% of patients had a significant fall risk, and 30% had a moderate risk. None of the patients had a history of falls or trauma-related hemorrhages. The ARISTOTLE study (50) examined the benefit-risk ratio of DOACs in fall-prone patients. In this study, patients on Apixaban had a significantly lower bleeding risk compared to those on Warfarin.

A recent analysis of the ENGAGE-AF TIMI 48 (51) trial, where patients were prospectively classified based on fall risk ("high" or "low") according to comorbidities and risk factors, showed that high-risk patients were more likely to experience bone fractures or major bleeding. The risk was reduced with Edoxaban compared to Warfarin. The Hart et al (52) study compared the incidence of traumatic intracranial hemorrhages (TICH) in patients on Dabigatran or Warfarin, finding a significantly lower TICH risk in those on Dabigatran.

The decision to initiate anticoagulation in fall-prone patients is complex and should be personalized, carefully weighing benefits against risks for each individual. Although fall risk is often considered an obstacle to anticoagulant use in the elderly, physicians tend to overestimate hemorrhagic risks in fall-prone patients. When anticoagulation is decided despite fall risk, it is crucial to address the risk factors: medication, environmental, postural and muscle rehabilitation, and provide therapeutic education.

4.2.2. Cognition

The issue of dementia and cognitive disorders is complex and multifactorial. First, the number of elderly individuals affected is increasing, which poses a growing challenge for healthcare systems. These conditions significantly impact patients' quality of life, leading to a loss of autonomy and behavioral changes. Management requires a multidisciplinary approach tailored to individual needs, while considering economic and social constraints.

The correlation between dementia and atrial fibrillation is gaining increasing attention in medical research. Studies have shown that AF patients are at high risk of developing dementia. The Rotteram study (53) was one of the first to identify this link, later confirmed by other studies such as Thaker et al. (54), Piguet et al. (55), and Tilvis et al. (56). A more recent study by Koh et al. (57) highlighted a major risk of dementia in patients with a history of stroke compared to those without. The BRAIN-AF study (58) attempted to clarify this relationship in patients with low stroke risk and compared the efficacy of Rivaroxaban to the reference treatment. Although the exact link between AF and dementia is still debated, silent cerebral ischemia due to microembolisms seems to be the most plausible mechanism, suggesting that anticoagulants could be effective in preventing dementia associated with AF.

Therefore, optimizing management with early anticoagulation prescription can help prevent or improve the prognosis of dementia in AF patients. The study by Kim et al. (59) showed a lower cumulative incidence of dementia in anticoagulated patients compared to those not receiving anticoagulants. Additionally, these patients were less likely to develop vascular dementia or Alzheimer's disease. Another study by Friberg et al. (60) suggested that oral anticoagulants in AF could protect against the onset and progression of dementia.

Cognitive assessment in the elderly is crucial for early detection of cognitive decline, guiding medical decisions, and preventing accidents by identifying those at risk. Several tests can be used for this assessment. In our study, we used two tests: the clock drawing test and the MMSE. The clock test evaluates visuospatial and executive functions, identifying errors that may indicate dementia, leading to further exploration with the MMSE, widely used to assess various cognitive aspects such as spatial and temporal orientation, memory, attention, calculation, language, and visuospatial ability.

In our study, half of the cohort had an MMSE score of 21 or less, suggesting possible dementia. The prevalence of cognitive impairment was 84% in AF patients and 3% in AF with ischemic stroke, consistent with other studies. Dementia can affect a patient's ability to report adverse effects or bleeding events and adhere to their medication regimen. As illustrated in the study by Drouin et al.(61) on DOAC adherence in the elderly, the main reason for poor adherence was forgetfulness.

To assist individuals with dementia in managing their medications, it is necessary to establish an accurate history, review all medications used, adopt behavioral strategies such as integrating routines, visual and auditory cues, and use

reminder tools and alarms. The study by Kamimura et al.(62) showed that using an automatic pillbox can help maintain autonomy and improve adherence. It is also important to raise awareness and involve not only the family but also all medical staff.

4.2.3. Co-medication

Co-medication refers to the simultaneous use of multiple medications, which is common in the elderly. The main concern is drug interactions, which can lead to side effects or increased toxicity, resulting in poor adherence. Our study specifically focused on DOACs, as their association with other drugs can compromise the effectiveness of treatment and affect the prognosis of patients.

Two categories of drugs are likely to interact with DOACs: P-glycoprotein inducers or inhibitors, which affect the absorption of Dabigatran and Rivaroxaban, and cytochrome P450 3A4 inducers and inhibitors, which metabolize Rivaroxaban and Apixaban. As with vitamin K antagonists, co-administration with azole antifungals, no steroidal anti-inflammatory drugs (NSAIDs), or other antithrombotics should be avoided.(63)

In our study, 37% were on antihypertensives, 40% on lipid-lowering agents, and 23% on oral antidiabetic agents. Furthermore, polypharmacy was common, with 47% of our patients taking at least 4 medications. The Chang et al. study (64) highlighted the hemorrhagic risk in AF patients on DOACs combined with up to 12 other medications. Consequently, the hemorrhagic risk was higher when DOACs were taken with other drugs compared to when used alone, with a predominance of intracranial and intestinal hemorrhages. Similarly, the ROCKET-AF (Rivaroxaban vs Warfarin)(65) and ARISTOTLE (Apixaban vs Warfarin) studies (66) showed that patients taking 5 or more medications had increased hemorrhagic events and mortality, proportional to the number of associated drugs.

Co-medication requires a dynamic, multidisciplinary approach to minimize drug interactions, improve patient safety, adherence, and optimize therapeutic benefits. Healthcare professionals should use patient-centered approaches to reduce or appropriately manage prescribed medications, offering knowledge and support. Several standardized and validated tools are available for monitoring co-medication, such as the Beers Criteria (67) and STOPP/START criteria.(68,69)

Scott's Deprescribing (70) acts in a patient-directed manner. It is a process of medication cessation or dose reduction, based on the relative benefits and risks. It is associated with a holistic review of the patient's medication list, clinical situation, and quality of life. It involves several steps:

- Examination and comparative assessment of medications.
- Evaluation of risks related to adverse effects.
- Assessment of each medication's eligibility for discontinuation.
- Prioritization of discontinuation.
- Discontinuation of treatment and implementation of a monitoring protocol.

4.2.4. Cachexia

Development of Malnutrition is a continuum, beginning with inadequate dietary intake followed by changes in biochemical indices and body composition. However, it remains a strong element in the screening of frailty in the elderly. The issue of malnutrition with DOACs lies in the major bleeding risk in malnourished patients. It requires thorough evaluation, close monitoring, and careful dose adjustments to minimize risks while optimizing benefits.

In clinical settings, malnutrition is generally confirmed by evaluating clinical complications or biological results such as hypoalbuminemia. In recommendations, the MNA is designed to assess the nutritional status of frail elderly individuals in the context of a Geriatric Evaluation. It is a quick and effective test composed of simple measurements and brief questions, such as: anthropometric measurements (weight, height, BMI), global assessment (lifestyle, medication, and mobility), diet, and a subjective evaluation (perception of health and nutrition).

In our study, nutritional status was assessed using the MNA test. Thus, 57% of our patients were at risk of malnutrition, 37% had poor nutritional status, and the rest had a normal profile.

Various studies have been conducted to evaluate the efficacy and safety of different DOAC molecules compared to Warfarin. The RE-LY study (Dabigatran vs Warfarin) (71) and the EINSTEIN-DVT and EINSTEIN-PE studies (Rivaroxaban vs Warfarin) (72) were performed on patients with a low weight < 50kg, showing a low incidence of hemorrhagic events in Dabigatran and Rivaroxaban compared to Warfarin.

Regarding Edoxaban and Apixaban, the HOKUSAI-VTE and ENGAGE TIMI-48 studies (Edoxaban vs Warfarin) and the ARISTOTLE study (Apixaban vs Warfarin) (73) conducted on patients with a weight < 60kg showed the impact of a 50% dose reduction of Edoxaban in reducing exposure to hemorrhagic risk. However, Apixaban presented a higher bleeding risk compared to Warfarin.

Moreover, the study by Shinohara et al., (74) exploring the impact of nutritional status on the prescription of DOACs in frail patients over 80 years old with atrial fibrillation (AF), showed that the risk of bleeding in malnourished patients on DOACs was lower than in those on Warfarin. DOACs bind to plasma proteins, particularly albumin, which acts as a reservoir. Malnutrition increases the free fraction of the anticoagulant and exposes to bleeding risk. However, the risk of malnutrition remains significant, and appropriate management is recommended.

Once the risk of malnutrition is identified, an etiological investigation is required. It is also advised to assess the patient's hydration status, as decreased food intake exposes to the risk of dehydration.

However, the attending physician is encouraged to develop an individualized management plan in collaboration with dietitians, including a combined approach to nutritional care such as: fractionated meals or snacks, varied diet, hydration, offering oral nutritional supplements, and in cases of failure or inadequacy of oral nutritional care with a compromised prognosis, enteral feeding may be proposed along with regular physical activity.

4.2.5. Cockcroft and Gault

DOACs are partially excreted by the kidneys with significant variations between different molecules: Apixaban has a low renal elimination of about 20%, whereas Dabigatran is about 80%. The main issue remains renal insufficiency, a common pathology in the elderly due to various physiological or pathological alterations. It is associated with an increased risk of both major hemorrhage and thrombotic events. This underscores the importance of dose adjustment based on glomerular filtration rate.

Renal function estimation in patients on DOACs should be performed using the Cockcroft-Gault formula. This formula is used in most randomized clinical trials to select patients, evaluate the impact of renal function on hemorrhagic and thromboembolic risks, and adjust dosages. (75)

In our study, renal clearance was calculated using the Cockcroft-Gault formula, and none of our patients had end-stage renal failure; however, one patient had severe renal insufficiency, and 15 patients had moderate renal insufficiency.

The main randomized studies of DOACs have allowed an evaluation of their efficacy compared to Warfarin, taking renal function into account in their samples. In the RE-LY study (76), hemorrhagic events under Dabigatran occurred before or concurrently with renal function deterioration. The ROCKET-AF study (77) showed that major bleeding was less frequent in patients on Rivaroxaban, with no heterogeneity in efficacy among patients with different dosages. In the ARISTOTLE study (43), Apixaban was safer than Warfarin for all levels of renal function. The same was true in the ENGAGE-AF TIMI 48 study (78), where Edoxaban was superior to Warfarin in terms of efficacy and safety regardless of renal function.

However, before initiating DOAC treatment, it is imperative to assess renal function using the Cockcroft and Gault method and ensure regular follow-up every three months. A decrease in CrCl from 80 to 30 mL/min leads to an increase in the elimination half-life of Dabigatran, making it contraindicated. Additionally, the administration of these medications should be avoided in acute situations such as diarrhea, vomiting, decreased fluid intake, diuretic therapy, or urinary retention.

The European Society of Cardiology (ESC) recommendations (26) regarding the adjustment of DOAC doses based on renal function in elderly patients

Table 3 The adjustment of DOAC doses based on renal function in elderly patients, according to ESC recommendations

Dabigatran	**Rivaroxaban**	**Apixaban**	**Edoxaban**
Adjust to 15mg/day if: ClCr = 15-49 ml/min.	Adjust to 15mg/day if : ClCr = 15-49ml/min.	Adjust to 2 x 2,5mg/day if 2 or 3 of the following criteria: Serum Creatinine > 133umol, weight≤ 60kg, age ≥ 80 years and/or severe renal insufficiency	Adjust to 30mg/day if : ClCr = 15-49ml/min. Weight ≤ 60kg

4.3. Strengths/Weaknesses of Our Study

4.3.1. Strengths of Our Study

Our study was conducted in a real-world setting, evaluating the prescription and monitoring of DOACs within a geriatric population. It allowed us to thoroughly and reliably examine the geriatric characteristics of our cohort using various evaluation tools available in the literature.

The study aimed to identify vulnerability factors specific to elderly individuals, considering their functional, psychological, and medical capabilities. By determining these aspects, it enabled us to design an adapted and coordinated care plan, integrating the multiple and often complex needs of our patients. This holistic approach promotes more effective long-term follow-up, aiming to improve the overall prognosis of patients. Its effectiveness is supported by numerous scientific studies demonstrating its positive impact compared to traditional approaches.

DOACs remain compatible and recommended geriatric medications, with promising usage due to their profile: fixed dosages, fewer drug interactions, no required biological monitoring, and a short half-life allowing for rapid elimination.

Limitations of Our Study

The sample size was small due to the monocentric nature of our study, and the results were not fully representative. This was partly due to some patients refusing to participate, despite being informed of the evaluation's benefits and positive effects. Therefore, the monocentric design introduced a representativeness bias compared to the general national population.

We also focused solely on evaluating patients on DOACs, which prevented us from comparing our population to those on other oral anticoagulants. Obstacles to using geriatric-focused tests and scales included a lack of experience with their use, difficulty in execution, and subjective responses, which made it challenging for physicians to make decisions. Time constraints were also an issue, as the evaluation process delayed consultations, subsequently affecting patient management. Thus, the most significant bias was related to the limited training and knowledge of physicians regarding geriatric care and management.

5. Conclusion

The integration of geriatric assessment in the management of these patients enables a more comprehensive and personalized approach, taking into account not only the medical aspects but also the functional, psychological, and social dimensions. By identifying early the specific needs and risks of elderly patients on DOACs, geriatric assessment allows for optimal adjustment of anticoagulant therapy, minimizing the risks of complications while maximizing therapeutic benefits.

Furthermore, it promotes a patient-centered approach by actively involving the patient in the management of their health and considering their preferences and treatment goals. It also helps identify needs related to social support, home care, or regular medical follow-up, thus improving the quality of life for elderly patients on DOACs.

Our work has thus highlighted the crucial importance of geriatric assessment in the management of elderly patients on direct oral anticoagulants. By integrating this approach into clinical practice, healthcare professionals can optimize the safety and effectiveness of anticoagulant treatment in elderly individuals while addressing their broader health needs.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Written informed consent was obtained from the patients for publication of this cases report.

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Availability of Data and Materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Author contribution

Author contribution

- MB: Study concept, Data collection, Data analysis, writing the paper.
- RL: Study concept, Data collection, Data analysis.
- RF: Study concept, Data analysis, writing the paper.
- NM: Supervision and data validation
- IA: Supervision and data validation
- AB: Supervision and data validation
- All authors reviewed the final manuscript.

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