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Implementation of an atrial fibrillation better care (ABC) pathway management strategy: Findings from the Iranian registry of atrial fibrillation

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ABSTRACT

Introduction: The Atrial Fibrillation Better Care (ABC) pathway is such an integrated care approach, recommended in guidelines. The aim of this service evaluation study was to evaluate the impact of implementing the ABC pathway in Iranian population.

Methods: In this prospective longitudinal cohort study, consecutive patients with a diagnosis of AF were initially evaluated. Patients at baseline were evaluated in hence of adherence to ABC pathway strategy. After study enrolment, first and second follow-up service evaluations were conducted at 6 and 12 months, respectively.

Results: The use of vitamin K antagonists (VKA) decreased from 25.1 % at enrolment to 13.8 % at follow-up; instead, non-VKA oral anticoagulants (NOAC) utilization increased from 40.0 % to 86.1 %, while antiplatelet treatment decreased from 34.9 % to 0 %. Use of antihypertensive drugs, ARBs, diuretics, and statins increased after implementation of the ABC pathway. Implementation of the ABC pathway approach led to a decrease in the occurrence of stroke/TIA (from 6.3 % to 2.2 %, $p = 0.002$), systemic thromboembolism (from 1.4 % to 0.0 %, $p = 0.04$), nose bleeds (from 0.8 % to 0.6 %, $p = 0.04$), skin bruising (from 1.2 % to 0.0 %, $p = 0.002$), and heart failure (from 7.7 % to 4.7 %, $p = 0.04$). The proportion of patients in EHRA Class I-II increased from 93.3 % at enrolment to 98.1 % at follow-up.

Conclusion: In this first study from a Middle East population, compliance with ABC pathway strategy in the management of AF was associated with optimization of management and general improvements in patient outcomes during follow-up.

1. Introduction

The global prevalence of atrial fibrillation (AF) is increasing due to the aging of populations and improved survival rates among individuals with chronic diseases. This trend has led to the characterization of AF as a global epidemic [1]. AF affects approximately 60 million adults globally, leading to increased cardiovascular morbidity and mortality rates, as well as enforcing social, psychological, and financial burdens on both patients and their families[2].

Based on recent guidelines, a holistic or integrated care management approach of patients with AF includes optimized stroke prevention, symptom control, and management of cardiovascular comorbidities [3,4]. Several studies have found that guideline-adherence management is associated with better patient outcomes including lower AF patient mortality [5–7].

The Atrial fibrillation Better Care (ABC) pathway strategy comprises three primary components: Avoiding stroke; Better symptom management through patient-centered symptom-directed rate or rhythm control; and Cardiovascular risk and other comorbidities optimization, including lifestyle changes[8]. Several research papers from Western

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and Asian countries have investigated the potential effectiveness of an ABC-adherent management strategy in reducing adverse clinical outcomes in patients with AF, including a reduction in mortality, stroke and bleeding, as well as hospitalisations [9]. However, there are limited data on such guideline-directed AF management from the Middle East.

In this service evaluation study, we presented results of the management and outcomes of Iranian AF patients based on the ABC pathway management strategy in a tertiary center. The present study will be the first prospective longitudinal cohort study to elucidate the impact of ABC pathway adherence in a Middle Eastern healthcare setting.

2. Methods and materials

This prospective longitudinal study enrolled consecutive AF patients who presented to the outpatient departments or were admitted to the hospital wards for further evaluation and treatment in the Iranian Registry of Atrial Fibrillation (IRAF). The study was conducted between December 2021 and February 2023 after approval by the local ethics committee (Approval ID: IR.RHC.RHEC.1401.087). All study procedures complied with the Helsinki Declaration. Participants provided written informed consent after explanation of the study protocol. An online registry software (https://registry.rhc.ac.ir) documented variables related to AF including clinical characteristics, symptoms, risk factors, scores, treatments, and procedures. Patients were followed for 12 months after initial evaluation.

Participants: All patients referred to cardiology outpatient clinics or admitted to the hospital with an AF diagnosis were evaluated on their initial visit, excluding those with Wolff-Parkinson-White syndrome or those aged under 15 years. Follow-ups were planned at 6 and 12 months after baseline evaluation.

The European Heart Rhythm Association (EHRA) symptom classification system was used to categorize the severity of atrial fibrillation symptoms in patients at each evaluation time-point [10]. The four symptom classes are: EHRA Class I: No symptoms − AF does not cause any symptoms. EHRA Class II: Mild symptoms − Symptoms do not affect normal daily activity and may include palpitations, dyspnea, fatigue, or dizziness. EHRA Class III: Severe symptoms − Symptoms affect normal daily activity with marked limitation. EHRA Class IV: Disabling symptoms − Debilitating symptoms causing discontinuation of normal daily activity and being bedridden.

AF was diagnosed as irregularly irregular R-R intervals without distinct repeating P waves in a single-lead ECG tracing of $\geq$ 30 s or the entire 12-lead ECG [11].

The CHA_2DS_2-VASc score was calculated based on: congestive heart failure (1 point), hypertension (1 point), age 75 years (2 points), diabetes mellitus (1 point), Stroke (2 point), vascular disease (1 point), age 65–74 years (1 point) and female gender (1 point) [12]. Patients with CHA_2DS_2-VASc = 0 (males) or 1 (females), CHA_2DS_2-VASc = 1 (males) or 2 (females), and CHA_2DS_2-VASc $\geq$ 2 (males) or 3 (females) were categorized as low, intermediate, and high risk for thromboembolic events. The HAS-BLED score was calculated based on: hypertension, renal disease (dialysis, transplant, Cr > 2.26 mg/ dL), liver disease (cirrhosis or bilirubin > 2x normal with AST/ALT/AP > 3x normal), stroke history, prior major bleeding or predisposition to bleeding, labile INR (unstable high INRs, time in therapeutic range < 60 %), elderly (age > 65), medication usage predisposing to bleeding, and alcohol usage (1 point for each of mentioned items) [13]. Patients were categorized in hence of bleeding risk based on following terms: low risk (HAS-BLED score $\leq$ 2), and high risk (HAS-BLED score $\geq$ 3).

Using the American Heart Association (AHA) guidelines, we evaluated the diagnosis of hypertension based on one of these three modalities (office-based, home-based, or ambulatory-based) [14]. Also, patients with a history of antihypertensive medications were considered hypertensive. Diabetes was diagnosed based on the American Diabetes Association (ADA) published the 2016 Standards of Medical Care in Diabetes [15].

2.1. ABC pathway adherence was defined as follows

A patient was regarded compliant with the criterion "A" if they were correctly provided oral anticoagulant (OAC) medication based on the CHA_2DS_2-VASc score. Oral anticoagulation (OAC) was deemed the most effective treatment for male patients with a CHA_2DS_2-VASc score of $\geq$ 1 or female patients with a CHA_2DS_2-VASc score of $\geq$ 2. Patients who did not meet the criteria for OAC therapy (CHA_2DS_2-VASc score of 0 in male patients or 1 in female patients) and were not receiving OAC treatment were also eligible for the "A" criterion. The OAC indication for the "A" criterion was based on the 2016 ESC AF guidelines [16]. For Criterion "B", patients who had an EHRA score of II (moderate symptoms not impairing day-to-day functioning) or I (no symptoms) were compliant for this criterion. For Criterion "C", we examined the following coexisting medical conditions linked to atrial fibrillation (AF): hypertension, coronary artery disease (CAD), peripheral artery disease (PAD), heart failure (HF), stroke or transient ischemic attack (TIA), and diabetes mellitus, and compliance with their associated guideline-recommended therapy. For example, in the case of hypertension, we defined regulated blood pressure as having a measurement of less than 140/90 mm Hg at the beginning of the study. All individuals who had a clinical condition that was not adequately treated were deemed to be non-adherent to the "C" criterion. Patients were seen as conforming to the ABC pathway if they met the criteria adherent with all three criteria. Patients who have not met at least one ABC pathway requirement were deemed to be noncompliant with ABC.

2.2. Statistical analysis

Statistical analysis was performed using SPSS software, version 23. Categorical and continuous variables were presented as number (%) and mean ± SD, respectively. The statistical significance in symptoms, clinical characteristics, and treatments were examined via Cochran's Q or Friedman test in three different stages of baseline, first follow-up and second follow-up.

3. Results

A total of 1,341 patients were finally enrolled in the present study. Among the total population, 710 patients (52.9 %) had a first follow-up, and 526 patients (39.2 %) had both first and second follow-ups (Fig. 1). The majority of the study population (n = 770, 57.4 %) were male, with the rest being female. The mean age of the study population was 60.7 ± 14.3 years (Table 1).

3.1. Avoid stroke with Anticoagulation

At initial evaluation, 324 patients (24.1 %) were classified as low risk, 220 patients (16.5 %) as intermediate risk, and 796 patients (59.4 %) as high risk for thromboembolic events based on their CHA_2DS_2-VASc score. In relation to bleeding risk, 1301 individuals (97.1 %) were classified as low risk, and 39 individuals (2.9 %) were classified as high risk of bleeding based on their HAS-BLED Score. Proportions of low risk, moderate risk, and high-risk patients based on HAS-BLED score were significantly decreased after the follow-ups (p-value < 0.001).

During the initial assessment, 200patients (25.1%) received treatment with vitamin K antagonist (VKA), 319 patients (40.0. %) were treated with non-Vitamin K antagonist oral anticoagulants (NOAC), and 278 patients (34.9 %) were treated with anti-platelet therapy (APT) (Table 2). The implementation of the ABC pathway resulted in a substantial increase in the prescription of NOACs, rising from 40.0 % at the beginning to 86.1 % at the end of the study (P < 0.001). The utilization of VKA reduced significantly from 25.1 % to 13.8 %, respectively (P < 0.001). Significantly, the utilization of Aspirin had an important decrease from 34.9 % to 0.0 % (p < 0.0001). Fig. 2 summarize prescribed oral anticoagulants during follow-ups.

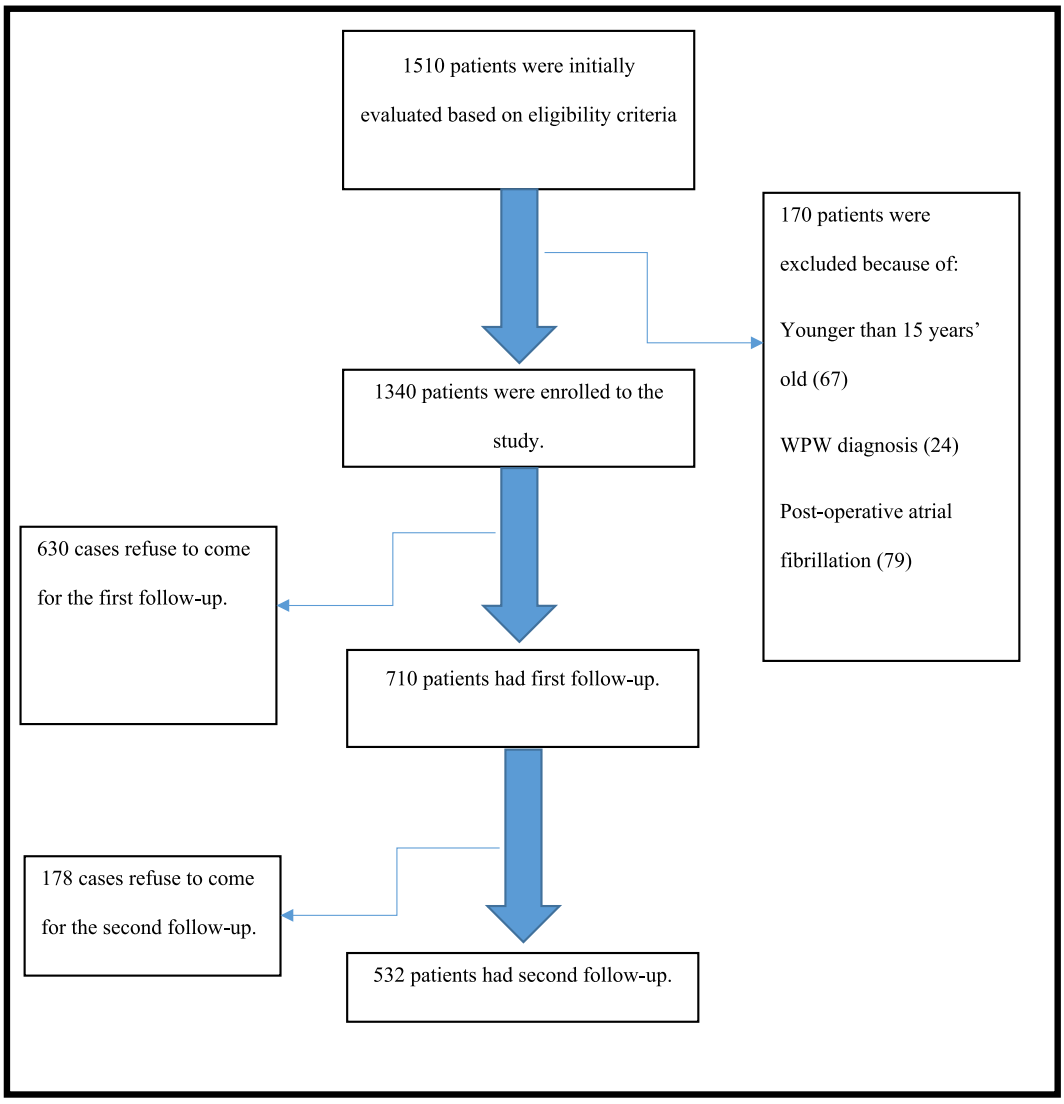

Fig. 1. Study flowchart.

3.2. Symptom control

The three most common symptoms were palpitations (69.4 %), dyspnea (25.5 %) and dizziness (7.1 %) among study population. After implantation of the ABC strategy in management of patients, palpitations decreased from 69.4 % at baseline to 32.0 % at follow-up. There were notable reductions in other symptoms, including a decrease in dyspnea from 25.5 % to 12.6 %, dizziness from 7.1 % to 1.4 %, and fatigue from 4.5 % to 1.1 %. Table 3 demonstrates the symptoms of IRAF registry during study follow-up.

In the initial assessment, a total of 701 patients (52.3 %), 549 patients (41.0 %), 86 patients (6.4 %), and 4 patients (0.3 %) were categorized into EHRA Classes I, II, III, and IV, respectively. EHRA class significantly improved during the study (p-value < 0.001). At the baseline evaluation, 701 patients (52.3 %) were classified as EHRA Class I. However, at the first follow-up, this classification applied to 497 patients (70.0 %), and at the second follow-up, it applied to 438 patients (83.1 %). Initially, 549 patients, constituting 41.0 % of the baseline cohort, were classified as EHRA Class II, but during the second follow-up, only 15.0 % of the total, remaining in EHRA class II.

EHRA class of the study population during the study follow-up is summarized in the Table 4. Fig. 3 demonstrates how EHRA class of the patients were improved over the course of the study.

After implantation of ABC pathway strategy, use of beta-blockers decreased from 78.2 % at baseline to 37.9 % at follow-up ($p = 0.01$). Also, use of Class 1c AAD decreased comparing baseline to follow-up, from 14.4 % to 13.1. Following the implantation of the ABC pathway, there was a significant increase in rhythm control interventions compared to baseline. The use of electrical cardioversion, chemical cardioversion, and catheter ablation increased from 17 (1.26 %), 1 (0.1 %), and 44 (3.2 %) at baseline to 102 (19.2 %), 32 (2.4 %), and 200 (14.9 %) at follow-up, respectively. Table 5 summarizes rate and rhythm control for the study population, including antiarrhythmic therapy, electrical cardioversion, chemical cardioversion, catheter ablation, and surgical ablation.

3.3. Cardiovascular risk factors detection and management

At the initial evaluation, 691 patients (51.5 %) were diagnosed with hypertension, 367 (27.3 %) had dyslipidemia, and 266 (19.8 %) were identified with diabetes. Use of antihypertensive therapy, ARBs, statins, and diuretics were notably increased during the follow-ups. Cardiovascular risk factors management is summarized in Table 6. Based on BMI, underweight, normal weight, overweight, and obese was evident in 25 (1.9 %), 686 (51.2 %), 417 (31.1 %), and 213 (15.9 %) of patients, respectively. The overall prevalence of hypertension, hyperlipidemia,

Table 1
Baseline characteristics of the study population.

Baseline characteristics		
Age		60.76 ± 14.35
Male		770(57.3)
Symptoms	**Palpitation**	931(69.3)
	Dyspnea	342(25.4 %)
	Angina	8(0.6 %)
	Dizziness	95(7.1 %)
	Pre-syncope	4(0.3 %)
	Syncope	34(2.5 %)
	Fatigue	61(4.5 %)
	Anxiety	23(1.7 %)
Hypertension		691(51.4 %)
Diabetes		266(19.8 %)
Hyperlipidemia		367(27.3 %)
Heart failure		241(17.9)
Chronic kidney disease		79(5.9 %)
Coronary artery disease		244(18.2 %)
Smoking		90(6.7 %)
Alcohol		12(0.9 %)
Opium		14(1.0 %)
COPD		14(1.0 %)
Familial AF		124(9.2 %)
Recent cardiac surgery		72(5.4 %)
Gastrointestinal bleeding		13(1.0 %)
CHA2DS2- VASc score	**0 (low risk)**	324(24.2 %)
	1 (intermediate risk)	220(16.4 %)
	≥ 2 (high risk)	796(59.4 %)
HAS-BLED score	**0 (low risk)**	715(53.3 %)
	1–2 (intermediate risk)	587(43.8 %)
	≥ 3 (high risk)	38(2.9 %)

COPD = chronic obstructive pulmonary disease, AF = atrial fibrillation, CHA_2DS_2-VASc score = The CHA2DS2-VASc score is a clinical tool used to assess the risk of stroke in patients with atrial fibrillation. Each letter in the abbreviation corresponds to a different risk factor: C: Congestive heart failure, H: Hypertension, A2: Age 75 years or older: Diabetes mellitus, S2: History of stroke or transient ischemic attack (TIA), V: Vascular disease (e.g., peripheral artery disease), A: Age 65–74 years, Sc: Sex category (female gender). Each factor is assigned a score, and the total score helps estimate the risk of stroke in patients with atrial fibrillation. HAS-BLED score = The HAS-BLED score is a clinical tool designed to assess the risk of bleeding in patients with atrial fibrillation who are prescribed anticoagulant therapy. It considers several factors: Hypertension, Abnormal renal/liver function, Stroke, history of Bleeding tendency or predisposition, Labile international normalized ratio (INR), Elderly (age > 65), Drugs/alcohol usage.

diabetes, heart failure, chronic renal disease, and coronary artery disease among the patients was 51.5 %, 27.3 %, 19.8 %, 18.2 %, 5.9 %, and 18.2 %, respectively.

At follow-up, better control of comorbidities was seen in hypertension and hyperlipidemia. After ABC strategy implantation, the prevalence of uncontrolled hypertension decreased from 51.4 % to 27.3 % at the first and 41.8 % at the second follow-up(p-value < 0.001).

3.4. Af-related outcome and complications

Following the implementation of the ABC pathway, the occurrence of stroke and systemic thromboembolic events decreased from 84 cases (6.3 %) and 19 cases (1.4 %) to 12 cases (2.2 %) and 0 cases (0 %), respectively. The incidence of heart failure reduced significantly from 103 cases (7.7 %) to 25 cases (4.7 %) (p = 0.001). Significantly, the occurrence of skin bruising decreased from 16 cases (1.2 %) to 0 cases (0 %) (p=0.002).

AF-related outcomes and complications of the study participants are summarized in Table 7.

4. Discussion

Based on results of our study, adherence to ABC pathway strategy for AF management was associated with optimization of management (particularly with NOAC use) and general improvements in patient outcomes, including symptoms and clinical outcomes during follow-up.

We observed that most AF-related major complications including stroke or TIA, systemic thromboembolism, myocardial infarction, nose bleeding, skin bruising, and heart failure significantly decreased after adherence to ABC pathway strategy.

At the baseline evaluation, most of our study participants were not managed according to the ABC pathway. Approximately one-third of non-ABC adherent patients were on aspirin. After two follow-ups and implementation of the ABC pathway in management protocols, the use of NOAC was significantly increased, and was associated with an overall decrease in systemic thromboembolism and stroke or TIA events. Our observations are consistent with prior reports, for example, from the Gulf Survey of Atrial Fibrillation Events (SAFE) Registry [17], FANTASIIA Registry [18], and the BALKAN-AF survey [19]. In the study of Guo et al., ischemic stroke was significantly lower in patients who were managed appropriately according to the ABC pathway strategy [20]. Hence, appropriate anticoagulant therapy use according to ABC pathway strategy is associated with decreased thromboembolic events.

Based on results of our study, symptoms such as palpitation, dyspnea, dizziness, and fatigue were significantly improved after implementation of ABC pathway management. This aligns with the findings of Pastori et al. [21], who highlighted the pivotal role of the B component in the ABC pathway, emphasizing better symptom management as crucial to its effectiveness. In our study, a similar approach led to a marked reduction in symptom severity, paralleling the decreased rate of cardiovascular events observed by Pastori et al. Furthermore, the study by Proietti et al. [22] corroborates the broader benefits of the ABC pathway, demonstrating not just a reduction in cardiovascular events but also a significant improvement in patient well-being through enhanced symptom control. This complementary evidence underscores the multifaceted impact of the ABC pathway, where the synergy between its components contributes to both the reduction of clinical events

Table 2
Changes in oral anticoagulant therapy in the study population over time.

	Baseline* (N = 1340)		First follow-up** (N = 710)		Second follow-up** (N = 532)		p-value
OAC- eligible	797		408		310		
OAC	VKA	200 (25.1 %)	VKA	102 (25.0 %)	VKA	43 (13.8 %)	<0.001
	NOAC	319 (40.0 %)	NOAC	306 (75.0 %)	NOAC	267 (86.1 %)	<0.001
	APT	278 (34.9 %)	APT	0 (0 %)	APT	0 (0 %)	<0.001

Oral anticoagulants (OAC); Vitamin K antagonist (VKA) i.e. Warfarin; Non-Vitamin K antagonist oral anticoagulants (NOAC) i.e. Apixaban, Rivaroxaban, Dabigatran; Anti-platelet therapy (APT) i.e. Aspirin, *= Individuals for whom data are unavailable to assess adherence to the ABC pathway.
** = Individuals who received treatment in accordance with the ABC pathway.

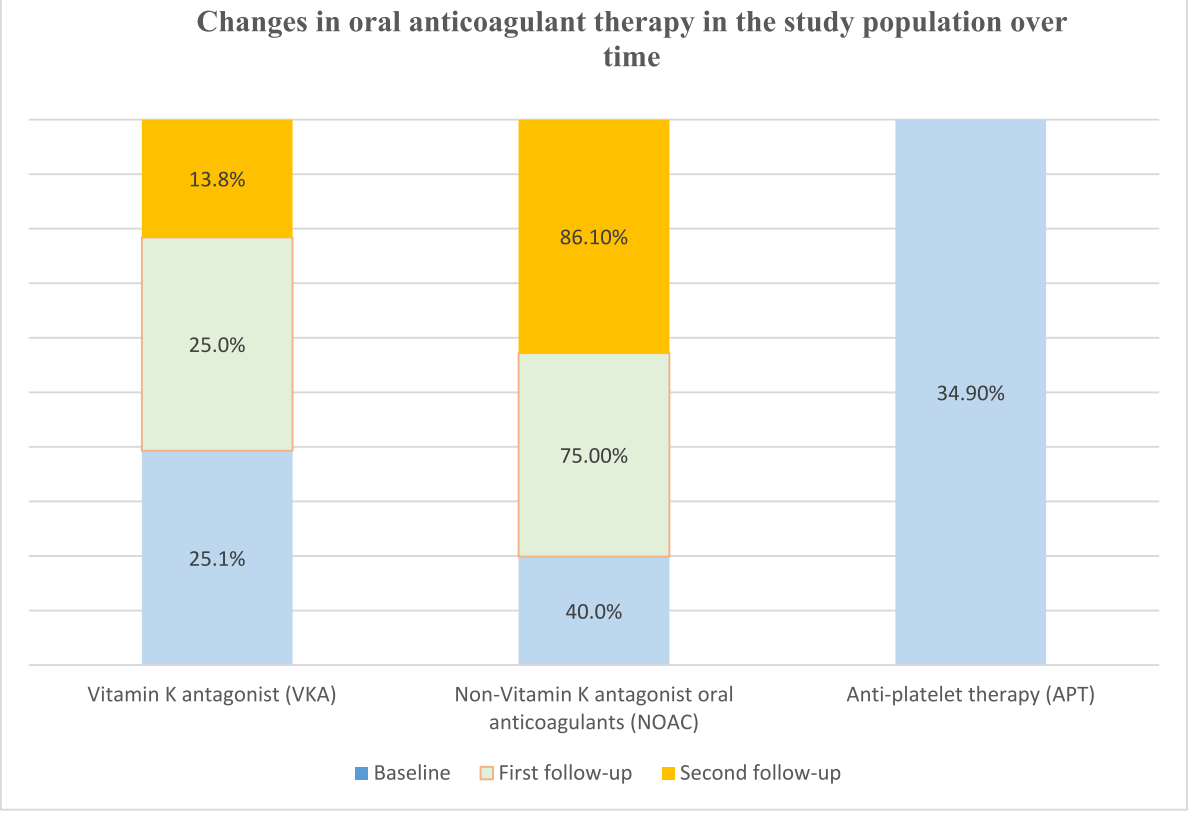

Fig. 2. Oral anticoagulant therapy of the study population during follow-ups.

Table 3
Symptoms in the study population over time.

	Baseline* (N = 1340)	1st follow-up** (N = 710)	2nd follow-up** (N = 532)	p-value
Asymptomatic	218(16.3 %)	270(38.0 %)	308(57.9 %)	<0.001
Symptomatic	1122(83.7 %)	440(62.0 %)	224(42.1 %)	<0.001
Palpitation	931(69.4 %)	345(48.6 %)	170(32.0 %)	<0.001
Dyspnea	342(25.5 %)	126(17.7 %)	67(12.6 %)	<0.001
Dizziness	95(7.1 %)	34(2.5 %)	19(1.4 %)	0.01
Fatigue	61(4.5 %)	24(1.8 %)	6(1.1 %)	0.01
Angina	8(0.6 %)	9(0.7 %)	6(1.1 %)	0.32
Pre-syncope	4(0.3 %)	3(0.2 %)	1(0.2 %)	0.17
Syncope	34(2.5 %)	18(1.3 %)	9(1.7 %)	0.59

* = Individuals for whom data are unavailable to assess adherence to the ABC pathway.;
** = Individuals who received treatment in accordance with the ABC pathway.

Table 4
EHRA class in the study population over time.

	Baseline* (N = 1340)	1st follow-up** (N = 710)	2nd follow-up** (N = 532)	p-value
EHRA class I	701(52.3 %)	497(70.0 %)	438(83.1 %)	<0.001
EHRA class II	549(41.0 %)	188(26.5 %)	79(15 %)	<0.001
EHRA class III	86(6.4 %)	25(3.5 %)	9(1.7 %)	<0.001
EHRA class IV	4(0.3 %)	0(0 %)	1(0.2 %)	<0.001

European Heart Rhythm Association (EHRA);
* = Individuals for whom data is unavailable to assess adherence to the ABC pathway;
** = Individuals who received treatment in accordance with the ABC pathway.

and the improvement of patient-reported symptoms. Our findings, alongside these studies, suggest that the ABC pathway offers a holistic approach to managing atrial fibrillation (AF), addressing both clinical outcomes and patient quality of life. The consistent observation across these studies of improved symptom control reinforces the notion that the ABC pathway is more than a clinical protocol; it's a patient-centric model that prioritizes patient comfort and well-being. In conclusion, use of the ABC pathway in AF patients is associated with better symptom control, showcasing its efficacy as a comprehensive management strategy in the context of cardiovascular care.

Our study also demonstrates just how adherence to ABC pathway strategy is important in achieving better outcomes with less complications including stroke, TIA, and other thromboembolic events. Notably, cases of stroke dropped from 6.3 % to 2.2 %, and systemic thromboembolic events were completely eliminated. Similarly, heart failure cases showed a substantial decrease, and instances of skin bruising were entirely eradicated. In line with our result, Proietti et al. found that adherence to the ABC pathway markedly decreased the rates of all-cause hospitalization and mortality among patients with atrial fibrillation, particularly in those with complex medical profiles. The research demonstrated a direct correlation between adherence to the ABC pathway and a significant reduction in these adverse outcomes [23]. Importantly, in the analysis of a substantial Chinese patient group with atrial fibrillation it was observed that compliance with the ABC pathway was independently linked to a decrease in the occurrence of all-cause mortality and a combined outcome of all-cause death, ischemic stroke, and intracranial hemorrhage [24]. Thus, it can be inferred that adherence to the ABC pathway represents a beneficial and effective strategy for enhancing the prognosis and reducing adverse outcomes in patients

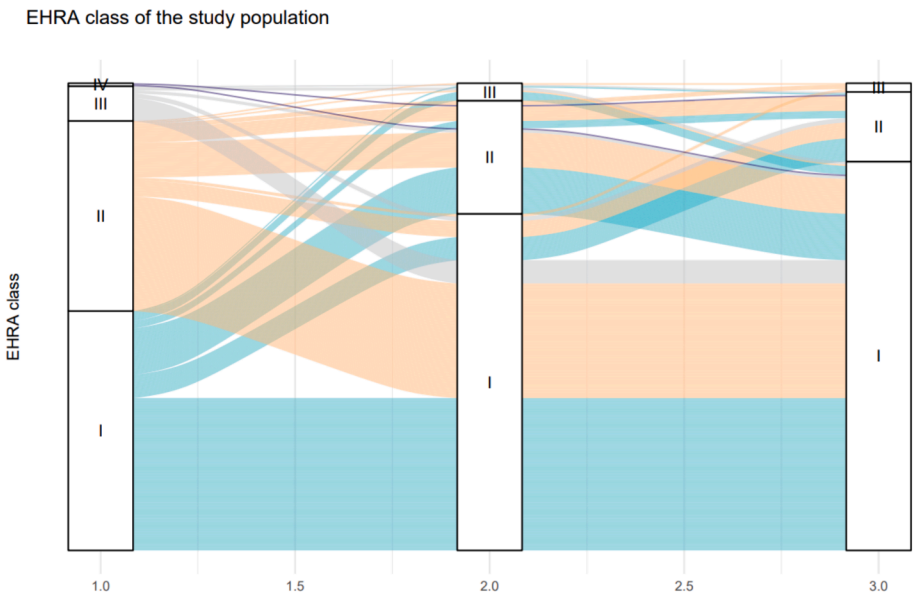

Fig. 3. Sankey diagram of EHRA class in the study.

Table 5
Rate and rhythm control at baseline and follow-up.

	Baseline (N = 1340)		1st follow-up (N = 710)		2nd follow-up (N = 532)		p-value
Antiarrhythmic drug	Beta-blockers 1048(78.2 %)		Beta-blockers 554(78.0 %)		Beta-blockers 202(37.9 %)		0.01
	Class 1c AAD 193 (14.4 %)	Flecainide 177(13.2 %)	Class 1c AAD 96 (13.5 %)	Flecainide 92(12.9 %)	Class 1c AAD70 (13.1 %)	Flecainide 62(11.6 %)	<0.001
		Propafenone 32 (2.4 %)		Propafenone 16 (2.3 %)		Propafenone 16(3.0 %)	
	Class III AAD315 (23.5 %)	Sotalol 95(7.1 %) Amiodarone 243(18.1 %)	Class III AAD170 (23.9 %)	Sotalol 46(6.5 %) Amiodarone 126(17.7 %)	Class III AAD125 (23.5 %)	Sotalol 29(5.4 %) Amiodarone 96(18.0 %)	0.01
	Calcium channel blockers 43(3.2 %)		Calcium channel blockers 25 (3.5 %)		Calcium channel blockers 12 (2.2 %)		0.48
Electrical cardioversion	17(1.26 %)		88(12.3 %)		102(19.2 %)		<0.001
Chemical cardioversion	1(0.1 %)		10(0.7 %)		32(2.4 %)		0.01
Catheter ablation	44 (3.2 %)		115(8.6 %)		200(14.9 %)		<0.001
Surgical ablation	6(0.4 %)		9(9.7 %)		0(%)		0.03

Table 6
Cardiovascular risk factor and comorbidity management.

		Baseline* (N = 1340)	1st follow-up** (N = 710)	2nd follow-up** (N = 532)	p-value
Hypertension management	**All anti-HTN drugs**	338(25.1 %)	275 (38.9 %)	233 (43.8 %)	<0.001
	ACEI	224(16.7 %)	118 (20.3 %)	85(18.5 %)	0.61
	ARBs	441(32.8 %)	264 (45.5 %)	186 (40.4 %)	0.001
	Diuretics	420(31.3 %)	245 (18.2 %)	193 (44.2 %)	<0.001
Dyslipidemia management	**Statins**	448(33.3 %)	254 (43.9 %)	189 (41.1 %)	<0.001

anti-arrhythmic drugs(AAD); Angiotensin-converting enzyme inhibitors(ACEI) i.e. captopril, enalapril; Angiotensin receptor blockers (ARBs) i.e. losartan, valsartan; statins i.e. atorvastatin, rosuvastatin; diuretics i.e. spironolactone, hydrochlorothiazide, furosemide; *= Individuals for whom data is unavailable to assess adherence to the ABC pathway., **= Individuals who received treatment in accordance with the ABC pathway.

Table 7
AF-related major complications of the study population.

	Baseline* (N = 1340)	1st follow-up** (N = 710)	2nd follow-up** (N = 532)	p-value
Stroke or TIA	84(6.3 %)	24(4.5 %)	12(2.2 %)	0.002
Systemic thromboembolism	19(1.4 %)	7(1.3 %)	0(0 %)	0.04
Myocardial infarction	2(0.1 %)	6(1.1 %)	2(0.4 %)	0.002
Nose bleeding	11(0.8 %)	3(0.6 %)	3(0.6 %)	0.04
Skin bruising	16(1.2 %)	1(0.2 %)	0(0 %)	0.002
GI bleeding	13(0.1 %)	4(0.7 %)	3(0.6 %)	>0.99
Intracranial bleeding	1(0.1 %)	0(%)	0(%)	–
Heart failure	103(7.7 %)	17(3.2 %)	25(4.7 %)	0.001
Mortality	3(0.2 %)	0(%)	1(0.2 %)	0.36

Transient ischemic attack (TIA);
* = Individuals for whom data is unavailable to assess adherence to the ABC pathway.
** = Individuals who received treatment in accordance with the ABC pathway.

with atrial fibrillation.

Telemedicine has an important role in management of cardiovascular disorders [25]. Lifestyle interventions via smartphone technology significantly lowered the ASCVD score at 1-year follow-up in high

cardiovascular risk patients compared to usual care alone[26].Importantly, at 1-year follow-up, smart device and mobile app technologies improved VO2 measurements in high cardiovascular risk patients compared to conventional treatment alone[27].Noteworthy to mention, digital health interventions are effective for follow-up care in the secondary prevention of acute coronary syndrome patients[28].Telemedicine has revolutionized AF management by providing remote access to healthcare services, enhancing patient monitoring, and improving outcomes[29]. Through telemedicine, patients with AF can receive timely consultations, real-time monitoring of their heart rhythm, and immediate medical advice without the need for frequent in-person visits [30,31]. Therefore, utilizing telemedicine within the ABC pathway strategy for managing AF should be regarded as a crucial approach for enhancing the care of AF patients.

4.1. Limitations

In this study, we focused on the ABC pathway strategy for AF in the real-world application and outcomes within the Iranian healthcare context. This provides valuable insights into its effectiveness in a non-Western population, contributing to the understanding of its global applicability and relevance.

However, there are several limitations to our study:

The absence of a control group makes it difficult to conclusively attribute the observed improvements solely to the ABC pathway. Future research should include controlled trials to better isolate and understand the specific impacts of the ABC pathway on patient outcomes.

The study had a follow-up drop rate of approximately 45 %, which could introduce bias and affect the robustness of our conclusions. The COVID-19 pandemic further exacerbated this issue, as some patients did not attend our center for follow-up. Future studies should focus on improving follow-up retention through enhanced patient engagement strategies and better tracking systems to ensure more reliable and comprehensive data.

The observed improvements in cardiovascular risk factors may partly result from enhanced monitoring and increased patient engagement during follow-up. Regular interactions likely improved adherence to therapies and lifestyle changes. Additionally, the intensity of follow-up itself may have significantly impacted adherence and outcomes, highlighting the combined effect of structured care pathways and continuous patient engagement in achieving better health outcomes.

5. Conclusion

In this pioneering study from a Middle Eastern population, the adoption of the ABC pathway strategy in managing AF was not only associated with optimized management but also with significant improvements in patient outcomes. These enhancements were evident in the effective symptom control, superior management of anticoagulant therapy, and the resultant positive impact on overall health status. By integrating comprehensive care components, the ABC pathway has proven instrumental in elevating the standard of AF treatment, ensuring that patient outcomes are not only targeted but also substantially improved. This strategy's success in our study underscores its potential as a transformative approach in AF management, emphasizing the importance of a holistic treatment perspective in contemporary healthcare practices.

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Availability of Data and Materials: The datasets used (extracted data from included studies) and analyzed during the current study are available from the corresponding author upon reasonable request.

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CRediT authorship contribution statement

Majid Haghjoo: Writing – review & editing, Project administration, Methodology, Conceptualization. **Amir Askarinejad:** Writing – review & editing, Writing – original draft. **Mona Heidarali:** Data curation. **Hooman Bakhshandeh:** Formal analysis. **Amirfarjam Fazelifar:** Data curation. **Zahra Emkanjoo:** Data curation. **Shabnam Madadi:** Data curation. **Farzad Kamali:** Data curation. **Fereidoun Noohi:** Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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