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Research paper

Association between atrial fibrillation, frailty, and geriatric syndromes in the late elderly in a south Belgian outpatient and inpatient setting

Christophe de Terwangne [a,b,*], Antonio Sorgente [c], Smarandita Macovei [d], Thibauld Preumont [e], Gianbattista Chierchia [f], Carlo de Asmundis [f], Antoine de Meester [g], Pierre Hanotier [a]

[a] Department of Geriatric Medicine, Hopital de Jolimont Groupe, 7100 La Louvière, Belgium
[b] Department of Geriatric Medicine, Cliniques Universitaires Saint-Luc – Université Catholique de Louvain, 1200 Brussels, Belgium
[c] Department of Cardiology and Rythmology, EpiCURA, 7301 Hornu, Belgium
[d] Department of Geriatric Medicine, EpiCURA, 7301 Hornu, Belgium
[e] Department of Internal Medicine, Hopital de Jolimont Groupe, 7100 La Louvière, Belgium
[f] Heart and Rhythm Management Center, Universitair Ziekenhuis Brussel - Vrije Universiteit Brussel, 1090 Brussels, Belgium
[g] Department of Cardiology, Hopital de Jolimont Groupe, 7100 La Louvière, Belgium

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ABSTRACT

Study objective: This study aims to analyze the relationship between AF, frailty, and geriatric syndromes in elderly patients in an outpatient and inpatient setting in a South Belgian hospital.
Participants, design and setting: This is a single center case-control retrospective study including 207 patients enrolled from an outpatient and inpatient setting of the Department of Geriatrics, Jolimont Hospital Group. Frailty was assessed using a complete geriatric assessment and Rockwoods Clinical Frailty Scale.
Results: AF was strongly associated with age, cardiovascular history, congestive heart failure, as well as with multiple geriatric syndromes such as vascular dementia, malnutrition, functional decline in Activities of Daily Living, mobility impairment and chronic ulcerous disease. Furthermore, there was a tight relationship between AF and Rockwoods' frailty phenotypes. This association was maintained throughout multivariable modelling including age (OR 1.06, IC 1.03–1.14, $p = 0.042$), sex (OR 2.30, IC 1.11–4.84, $p = 0.026$), congestive heart failure (OR 3.70, IC 1.77–7.91, $p < 0.001$) and a CFS more than 4 (OR 2.68, IC 1.18–6.43, $p = 0.021$).
Conclusion: A deeper understanding of associations between atrial fibrillation and geriatric syndromes and frailty could give new patient management perspectives beyond pharmaceutical or interventional treatment.

1. Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia encountered in the geriatric population and is associated with significant morbidity and mortality [1–3]. The advent of preventive pharmacological and non-pharmacological measures against cardiovascular diseases in the last decades have allowed a significant positive demographic shift in the general population [4]. This has translated progressively in the aging of the general population and, therefore, of patients with AF. Epidemiology and management of AF in the elderly has not yet been deeply investigated, since this part of the population is usually under-represented in the majority of randomized clinical trials.

Considering that patients with AF have higher risk of incident acute heart failure hospitalizations [5,6], ischemic and hemorrhagic stroke [7] and dementia [8], it is undeniable that their quality of life can be affected accordingly. This aspect is particularly important in the elderly, in whom it seems to be inversely correlated to frailty and functional decline [9]. Frailty is a complex condition affecting elderly people, characterized by the loss of physiological mechanisms of repair and compensation which predispose them to worse outcomes [10].It is still controversial if AF can contribute to frailty [11–13] . The high heterogeneity of the inclusion and exclusion criteria, as well as of the primary and secondary outcomes and of the frailty scores and scales of the studies aiming at assessing this association has rendered comparisons challenging. A deeper understanding of the correlations between frailty phenotypes, geriatric syndromes and functional decline with AF could however give new perspectives in patients' management and have pushed to design the present study.

* Corresponding author at: Department of Geriatric Medicine, Cliniques Universitaires Saint-Luc, Avenue Hippocrate 10, 1200 Bruxelles, Belgium.
E-mail address: christophe.deterwangne@saintluc.uclouvain.be (C. de Terwangne).

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This study aims indeed to analyze the relationship between AF, frailty, and geriatric syndromes in elderly patients in an outpatient and inpatient setting in a South Belgian hospital.

2. Materials and methods

Patients were selected in a retrospective fashion among all who were admitted in the Department of Geriatrics or among who had a consultation in the outpatient Department of Geriatrics, Hopital Jolimont, La Louvière, in the period between May 1st 2021 and July 31st 2021. Inclusion criteria were age $\geq$ 75-year-old, completion of a complete geriatric assessment (CGA) and a 12-lead baseline ECG recording. Patients were excluded if they were admitted for palliative care or presented severe dementia with limiting possibility of cooperation.

Demographic data, cardiovascular risk factors, medication, cardiac history, and results from CGA were extracted from the electronic medical records by 2 clinicians independently. AF was diagnosed on a 12-lead ECG recording and type of AF was based on medical history.

In the present study, 2 different methods were used to assess functionality and frailty of patients. The first one was CGA [14]. It usually provides data on specific items and geriatric syndromes including living independency, functional status measured by the Katz Activities of Daily Living score [15], number of drugs taken, diagnosis of dementia, a MiniMental State Examination (MMSE), recent history of falls or syncope, mobility impairment, nutrition status, continence, chronic ulcerous disease (pressure ulcers or chronic limb ulcers), recent hospitalizations, and depression. These items give a relatively complete picture of the patient functionality and are routinely assessed in our inpatient and outpatient setting. Living independency was categorized as living independently at home alone or with a spouse, living at home alone or with a spouse with at least a daily paramedical aid, or living in a nursing home. Dementia was defined as suspected (MMSE<24, without neuropsychological testing and cerebral MRI), confirmed (neuropsychological testing and cerebral MRI) neurodegenerative, confirmed vascular, confirmed mixt dementia (neurodegenerative and vascular), or absence of dementia. Mobility was defined as walking without aid, walking with either a walking stick or rollator, or bedridden (unable to carry out bed-chair transfers without human aid). Nutrition status was defined according to the Mini Nutrition Assessment Short Form (MNAsf): normal nutrition status if MNAsf >11, at risk of malnutrition if MNAsf between 8 and 11, and malnourished if MNAsf <8 [16].

The second method used to assess functionality and frailty of patients was the Rockwood's Clinical Frailty Scale (CFS) version 2.0, which usually allows to determine 9 clinical frailty phenotypes [17,18].

The local Ethics Committee approved the study protocol on the 6^{the} of July 2021 and waived the need for an informed consent. The study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Statistical analysis was performed using R: A Language and Environment for Statistical Computing, version 4.1.1, R Core Team, Vienna, Austria, 2021. Descriptive statistics were computed for all study variables. Categorical variables were expressed as percentages and continuous variables as mean (SD) or median [25th–75th percentiles] as appropriate. Differences between patients with atrial fibrillation and without were assessed using the chi-square test or Fischer Exact test for categorical variables, and Wilcoxon Rank-sum test for continuous variables.

The main endpoint of the study was to evaluate the strength of the association between AF, frailty using Rockwood's Clinical Frailty Scale and geriatric syndromes using a complete geriatric assessment through univariable and multivariable analysis. Multivariable logistic regression models were run to adjust univariable analysis for potential confounding factors. Through univariable and multivariable modelling, multilevel factorial variables were dummy coded for analysis. Different models were computed with a maximum of 6 simultaneous potential independent predictors to avoid multicollinearity. Variables showing collinearity i.e., a variance inflation factor (VIF) greater than five, were excluded from the model. To construct adequate multivariable models, stepwise regression was conducted with a *p*-value threshold of 0.1. Patients with missing data in one of the studied variables were excluded from model analysis (total N included are reported). Only variables with less than 10% missing data were included in the analysis. Throughout analysis, a *p*-value below 0.05 was considered as statistically significant.

3. Results

Demographic data are represented in Table 1. A total of 207 patients were included in the analysis with a mean age of 84 (range 79–88) year-old. 145 (70%) patients were female. 93 (45%) patients were enrolled from the geriatric outpatient's clinic whereas 114 (55%) were enrolled in the inpatient geriatric setting. 47 (23%) patients lived independently at home, 100 (48%) patients lived at home with at least one paramedical aid per day, and 60 (29%) patients were institutionalized. 76 (37%) patients were diagnosed with AF (Table 2) of which 6 (7.9%) had de novo AF, 31(40.8%) had paroxysmal AF, 8 (10.5%) had persistent AF and 31 (40.7%) had permanent AF. Patients with AF were older than those without AF ($p = 0.005$) and AF was more frequent in hospitalized patients than patients at geriatric outpatient clinic ($p < 0.001$). AF was associated with history of stroke ($p = 0.015$). Patients with AF had more general cardiovascular history: 80 patients without AF had no cardiovascular history versus 7 with AF ($p < 0.001$). AF was associated with congestive heart failure (CHF) ($p < 0.001$), heart failure with reduced ejection fraction (HFrEF)($p < 0.001$) and heart failure with preserved ejection fraction (HFpEF)($p = 0.009$). Patients with AF had more implanted pacemakers ($p = 0.001$).

From the CGA (Table 4), patients with AF did present more dependency for daily living activities (Katz-ADL) compared to patients without AF ($p = 0.036$). Those patients did more frequently need aid for walking and were more often at risk of malnutrition or malnourished ($p = 0.004$, $p = 0.006$ and $p = 0.007$ respectively). Dementia was not associated with AF, but if patients with confirmed neurodegenerative disorders were pooled apart, AF did show to be more frequent among patients with vascular dementia. AF patients did present more chronic ulcerous disease ($p = 0.035$). Polypharmacy was important among studied patients, but no difference was found in the number of drugs taken between patients with AF and without AF. Mean CFS score is significantly higher in patients with AF ($p < 0.001$) (Fig. 1). 19% of patients with a CFS from 1 to 3 have AF, 37% of patients with a CFS between 4 and 6 have AF and 51% with a CFS between 7 and 9 have AF (Table 3). Difference in frequencies of AF between those subgroups of CFS is statistically significant ($p = 0.008$).

After multivariable modelling with AF as dependent variable (Table 5A), age (OR 1.06, IC 1.03–1.14, $p = 0.042$), sex (OR 2.30, IC 1.11–4.84, $p = 0.026$), congestive heart failure (OR 3.70, IC 1.77–7.91, $p < 0.001$) and a CFS more than 4 (OR 2.68, IC 1.18–6.43, $p = 0.021$) showed all to be independently related to AF. Nutrition status, however, did lose significance.

Multivariable modelling with a CFS more than 4 as dichotomous dependent variable (Table 5B) illustrates a significant and independent association with AF (OR 2.72, CI 1.21–6.47, $p = 0.019$) and malnutrition (OR 4.33, CI 2.12–9.04, $p < 0.001$). Age, sex, CHF and context of enrollment did not show to be associated with a CFS above 4 in this model.

4. Discussion

The main finding of our study is that, in a geriatric outpatient and inpatient setting, older patients, male patients, patients with CHF and patients with a CFS $\geq$ 5 have more probably a concomitant diagnosis of AF.

This monocentric case-control retrospective analysis highlights therefore a quite underexplored relationship between AF and

Table 1
Baseline descriptive statistics grouped by presence or absence of atrial fibrillation.

	N	Overall, N = 207	Atrial fibrillation		p-value[b]
			No, N = 131[a]	Yes, N = 76[a]	
Demographic					
Age	207	84 (79, 88)	83 (78, 87)	86 (82, 89)	**0.005**
Sex	207				0.2
Woman		145 (70%)	96 (73%)	49 (64%)	
Man		62 (30%)	35 (27%)	27 (36%)	
Provenance	207				0.2
Independent		47 (23%)	34 (26%)	13 (17%)	
Institutionalized		60 (29%)	40 (31%)	20 (26%)	
Partly dependent		100 (48%)	57 (44%)	43 (57%)	
Context of enrolment	207				**<0.001**
Outpatient clinic		93 (45%)	73 (56%)	20 (26%)	
Hospitalized		114 (55%)	58 (44%)	56 (74%)	
Cardiovascular risk factors					
None	207	20 (9.7%)	12 (9.2%)	8 (11%)	>0.9
Peripheric arteriopathy	207	22 (11%)	13 (9.9%)	9 (12%)	0.8
TIA	207	6 (2.9%)	3 (2.3%)	3 (3.9%)	0.7
Stroke	207	38 (18%)	17 (13%)	21 (28%)	**0.015**
Diabetes	207	66 (32%)	42 (32%)	24 (32%)	>0.9
Hypercholesterolemia	207	97 (47%)	65 (50%)	32 (42%)	0.4
Obstructive sleep apnea	207	7 (3.4%)	3 (2.3%)	4 (5.3%)	0.3
Metabolic syndrome	207	13 (6.3%)	6 (4.6%)	7 (9.2%)	0.2
Hypertension	207	160 (77%)	106 (81%)	54 (71%)	0.14
Tabac	207	25 (12%)	14 (11%)	11 (14%)	0.6
Cardiac history					
None	207	87 (42%)	80 (61%)	7 (9.2%)	**<0.001**
Congestive heart failure	199	59 (30%)	22 (18%)	37 (49%)	**<0.001**
Valvular cardiomyopathy	207	29 (14%)	15 (11%)	14 (18%)	0.2
Ischemic cardiomyopathy	207	38 (18%)	22 (17%)	16 (21%)	0.6
HFpEF	207	37 (18%)	16 (12%)	21 (28%)	**0.009**
HFrEF	207	10 (4.8%)	1 (0.8%)	9 (12%)	**<0.001**
PCMK	207	19 (9.2%)	5 (3.8%)	14 (18%)	**0.001**
Complete geriatric assessment and frailty					
Dementia	189				0.063
None		66 (35%)	50 (40%)	16 (25%)	
Suspicion		67 (35%)	37 (30%)	30 (46%)	
Neurodegenerative		28 (15%)	21 (17%)	7 (11%)	
Vascular		14 (7.4%)	9 (7.3%)	5 (7.7%)	
Mixt (Neurodegenerative and vascular)		14 (7.4%)	7 (5.6%)	7 (11%)	
Dementia vascular pooled	207	95 (46%)	53 (40%)	42 (55%)	0.055
MMSE	188	22 (17, 26)	23 (18, 26)	21 (17, 24)	0.059
Number of drugs	207	8.0 (6.0, 10.0)	8.0 (6.0, 10.0)	9.0 (7.0, 10.0)	0.3
Polypharmacy	207				0.3
<5 drugs		22 (11%)	17 (13%)	5 (6.6%)	
5–9 drugs		117 (57%)	71 (54%)	46 (61%)	
>9 drugs		68 (33%)	43 (33%)	25 (33%)	
Mobility	201				**0.010**
Without aid		78 (39%)	59 (47%)	19 (25%)	
With mechanic aid		106 (53%)	58 (46%)	48 (64%)	
Bedridden		17 (8.5%)	9 (7.1%)	8 (11%)	
Falls	197				0.2
Bedridden		15 (7.6%)	7 (5.5%)	8 (11%)	
No		137 (70%)	88 (69%)	49 (70%)	
Yes		45 (23%)	32 (25%)	13 (19%)	
Swallowing disorder	194	26 (13%)	14 (11%)	12 (18%)	0.3
Incontinence	200				0.4
Continent		113 (56%)	76 (59%)	37 (52%)	
Partly continent (faecal or urinary)		57 (28%)	37 (29%)	20 (28%)	
Incontinence (faecal and urinary)		30 (15%)	16 (12%)	14 (20%)	
Malnutrition	202				**0.008**
At risk of malnutrition		74 (37%)	43 (33%)	31 (44%)	
Absence of malnutrition		68 (34%)	54 (41%)	14 (20%)	
Malnutrition		60 (30%)	34 (26%)	26 (37%)	
Depression	207	45 (22%)	34 (26%)	11 (14%)	0.079
Recent hospitalization (last 6 months)	207	63 (30%)	37 (28%)	26 (34%)	0.5
Chronic ulcerous disease	207	14 (6.8%)	5 (3.8%)	9 (12%)	**0.054**
Activities of daily living (Katz)	205	11.0 (8.0, 15.0)	10.0 (7.0, 15.0)	12.0 (9.0, 17.0)	**0.015**
Clinical frailty scale	198	5.00 (4.00, 6.00)	5.00 (3.00, 6.00)	6.00 (5.00, 7.00)	**<0.001**
Clinical frailty scale categorical	198				**<0.001**
<5		70 (35%)	56 (44%)	14 (19%)	
>5		128 (65%)	70 (56%)	58 (81%)	

TIA = Transient Ischemic Attack, HFpEF = Heart Failure with Preserved Ejection Fraction, HFrEF=Heart Failure with Reduced Ejection Fraction. PCMK = Pacemaker , MMSE = Mini Mental State Examination
N = represents the number of included cases per analysis ($N_{TOT} - N_{MISSING}$). Significant p-values are highlighted in bold.
[a] Statistics presented: median (IQR); n (%).
[b] Statistical tests performed: Wilcoxon rank-sum test; chi-square test of independence.

Rockwoods' frailty phenotypes among elderly patients (Fig. 1). More importantly, the association is maintained throughout multivariable modelling adjusted for age, sex, and CHF, which are classical clinical features closely related to AF. Finally, the context of patient enrollment (outpatient clinic or inpatient setting) did not influence the strength of these associations.

Along with aging and growing multimorbidity, the understanding of

Table 2
Atrial fibrillation frequencies and subtypes.

	N = 207[a]
Total AF	76 (37%)
De novo	6 (2.9%)
Paroxysmal	31 (15%)
Persistent	8 (3.9%)
Permanent	31 (15%)

[a] Statistics presented: n (%)

frailty phenotypes and functional reserve in patients with AF is gaining interest in the challenge of finding the most adequate therapeutic approaches aiming at preserving quality of life, especially in the elderly.

Assessing frailty has been until today challenging due to the very heterogenous profiles of geriatric patients. Different approaches have been proposed and used in studies assessing associations between AF and frailty. As for example, Koca et al., used The Fried frailty score, based on five criteria (weight loss, handgrip strength, exhaustion, gait speed and physical activity level) [19,20], and a CGA to study the relationship between AF and frailty. They concluded that AF is associated with worse metabolic profile and clinical features on CGA, which suggests that AF might be a frailty marker. The Katz ADL score assesses functional status and was used by Parks et al. to demonstrate a loss of functional status following AF diagnosis independently of stroke [21]. Even more complex composite frailty indexes such as suggested by Searle et al. assesses up to 40 variables and was used by Polidoro et al. [22,23]. Orkaby et al. did utilize the Fried frailty score and Rockwood's CFS to study bidirectional association between incident AF and incident Frailty on a community dwelling cohort. They could not obtain sufficient statistical power to explain causal relationship in their study.

In the present study, 2 separate methods were implemented to assess patients' clinical status: the CGA and the Rockwood's CFS scale.

The CGA, routinely used as reference for multimodal frailty assessments in geriatric settings, comprises several items and gives a detailed picture of the clinical status, geriatric syndromes, and the evaluation of functional reserves. The CGA was used in this study to assess specific associations between AF and geriatric syndromes.

Rockwood's CFS scale is based on physicians' clinical judgment of functional impairments and has been shown to be easily assessed, to be an accurate frailty screening tool, and is increasingly used in multiple settings [24]. It returns a scale of nine levels from the first being "very fit" to nine being "terminally ill" [18]. The CFS is therefore useful to enrich the CGA with a continuous score of clinical frailty phenotypes. The present study does indeed point out in the univariable analysis, that one point increase of CFS increase the odds to have AF by a factor 1.48 (48%) (OR:1.48 CI:1.22–1.81 $p < 0.001$). After adjusting for age, sex, CHF and malnutrition, frailer patients (CFS greater or equal than 5) have a nearly three times increase in odds to have AF (adjusted OR 2.68, CI 1.18–6.43, $p = 0.021$) compared to less frail patients (CFS less than 5).

From the univariable analysis of the different items from CGA (Table 4.), several direct or indirect associations were found between AF

Table 3
Frequency of atrial fibrillation per subgroup of the CFS score.

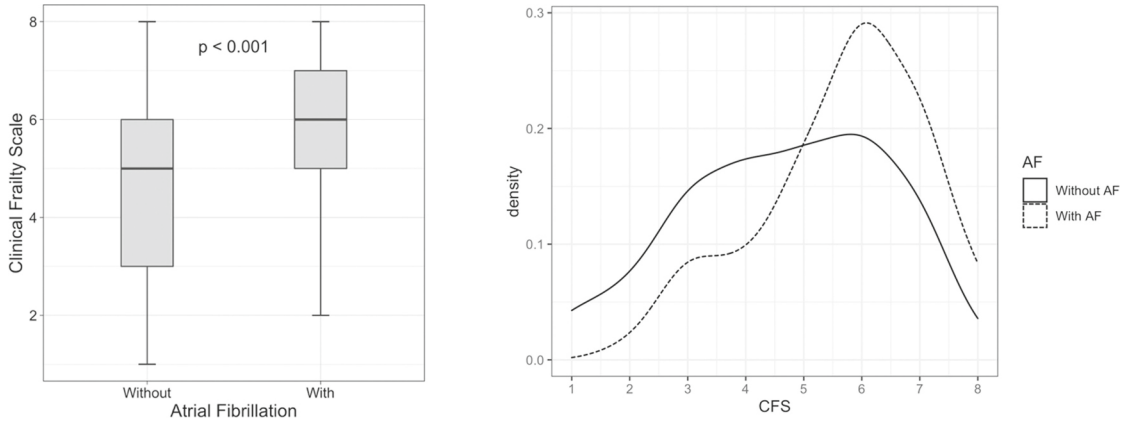
	CFS		
	1–3	4–6	7–9
AF			
Without	34 (81%)	71 (63%)	21 (49%)
With	8 (19%)	42 (37%)	22 (51%)
Total	42 (100%)	113 (100%)	43 (100%)

Chi-square test of independence, $p = 0.008$.

Table 4
Univariable analysis of demographic and statistically significant Geriatric syndromes in function of AF.

	N	OR[a]	95% CI[a]	p-value
Age (per year)	207	1.08	1.03, 1.14	**0.003**
Sex	207			
Woman		–	–	
Man		1.51	0.82, 2.78	0.2
Activities of daily living (Katz)	205	1.06	1.00, 1.11	**0.036**
Clinical frailty scale	198	1.48	1.22, 1.81	<0.001
Dementia	189			
None		–	–	
Suspicion		2.53	1.22, 5.41	**0.014**
Neurodegenerative		1.04	0.36, 2.83	>0.9
Vascular		1.74	0.48, 5.82	0.4
Neurodegenerative and vascular		3.12	0.94, 10.5	0.060
Vascular dementia pooled	207	1.82	1.03, 3.23	**0.040**
Mobility	201			
Without aid		–	–	
With mechanic aid		2.57	1.37, 4.97	**0.004**
Bedridden		2.76	0.92, 8.25	0.066
Malnutrition	202			
Absence of malnutrition		–	–	
At risk of malnutrition		2.78	1.34, 6.01	**0.007**
Malnutrition		2.95	1.37, 6.56	**0.006**
Chronic ulcerous disease	207	3.39	1.12, 11.4	**0.035**

N = represents the number of included cases per analysis ($N_{TOT} - N_{MISSING}$). Significant p-values are highlighted in bold.
[a] OR = Odds Ratio, CI = Confidence Interval.



A. Difference in mean of CFS among patients with and without AF.

B. Relative frequency distribution of patients in function of CFS. AF = Atrial Fibrillation.

Fig. 1. Clinical Frailty Scales among patients without and with Atrial Fibrillation

and geriatric syndromes such as vascular dementia, malnutrition, functional decline in Activities of Daily Living, mobility impairment and chronic ulcerous disease.

Cognition is a major component of the CGA and, by definition, influences the CFS score. The relation between dementia and AF seems to be well established [8,25]. This relation is also confirmed in our study but only when patients with established neurodegenerative dementia were pooled apart. Compared to patients without dementia or neurodegenerative dementia, patients with a suspected vascular component of dementia are associated with a nearly two-fold increase of AF (OR = 1.82, CI:1.03–3.23, p = 0.040). Physiopathology of the vascular etiology has indeed been hypothesized through the occurrence of microembolism, microbleeds and chronic inflammatory state secondary to AF and its associated cardiovascular risk factors [26]. Effects of well conducted anticoagulation therapy on incident dementia, however, remains unclear.

Another significant aspect included in the CGA is nutrition. The present work highlights a nearly three-fold increase in AF in patients at risk of malnutrition or confirmed malnourished compared to patients without malnutrition (At risk of malnutrition OR 2.78 CI 1.34–6.01, p = 0.007, malnourished OR:2.95, CI:1.37–6.56, p = 0.006). During stepwise multivariable modelling with AF as dependent variable, however, malnutrition did lose significance after introducing frailty phenotypes with a CFS greater than 4. The latter demonstrates, in addition to the model with CFS as dependent variable (Table 5B), that the association between AF and malnutrition is secondary to frailty: patients with AF are frailer, and frailer patients are more often malnourished [27]. A second hypothetic explanation could be found in the triangular relation between AF, heart failure and malnutrition: it has indeed been stated that CHF patients are more frequently malnourished [28].

Malnutrition, worse functional status measured by the Katz ADL score (OR 1.06 CI:1.00–1.11, p = 0.036), walking impairment, and CHF in patients with AF can furthermore explain, at least partially, the association between chronic ulcerous disease and AF found in this study: on one hand, patients with impaired mobility or bedridden are by definition frailer, which, along with malnutrition, predispose to pressure ulcers [29], and on the other hand, CHF participates in venous stasis which does also in turns contributes to impeded local healing, especially in ankle edema.

Of course, as suggested by previous studies and reinforced in the present one, CHF is strongly associated with AF (adjusted OR 3.71, CI:1.76–8.03, p < 0.001) and optimal medical management of heart failure remains a key point in patients with AF. Along with frequent need of rate control, eventual attempt for medical rhythm control, and strong evidence for need for stroke prevention by anticoagulation therapy [30], AF patients are often exposed to polypharmacy [31,32]. Moreover, patients with AF frequently present multiples comorbidities and several cardiovascular risk factors which do require each of one adequate treatment [33]. Polypharmacy among patients with AF is associated with an increase of all-cause mortality, augmented relative risk for cardiovascular events, increased risk of major and non-major bleeding events, hospitalization and reduced quality of life [32,34,35]. Hence, medical treatment reconciliation efforts should be a central pilar in the management of elderly patients with AF. Frequency of polypharmacy was high in the present study with only 11% of patients taking less than 5 drugs, but the lack of significancy between patients with and without AF, is probably due to the relatively small number of included patients and the fact that patients in this study were recruited in hospital environment presenting polypharmacy secondary to other pathologies.

Table 5A
Multivariable analysis with AF as independent factor.

	OR[a]	95% CI[a]	p-value
Age	1.07	1.01, 1.14	**0.031**
Sex			
Woman (reference)	–	–	
Man	2.32	1.11, 4.96	**0.027**
CHF	3.71	1.76, 8.03	**<0.001**
Clinical frailty scale categorical			
<5 (reference)	–	–	
≥5	2.68	1.18, 6.43	**0.021**
Malnutrition	1.85	0.78, 4.53	0.2
Context of enrolment			
Outpatient clinic (reference)	–	–	
Hospitalized	1.98	0.95, 4.17	0.068

N included in modelling = 191. Significant p-values are highlighted in bold.
[a] OR = Odds Ratio, CI = Confidence Interval.

Table 5B
Multivariable analysis with CFS ≥5 as independent factor.

	OR[a]	95% CI[a]	p-value
Age	1.02	0.96, 1.08	0.5
Sex			
Woman (reference)	–	–	
Man	0.54	0.26, 1.13	0.10
CHF	1.23	0.53, 2.95	0.6
AF	2.72	1.21, 6.47	**0.019**
Malnutrition	4.33	2.12, 9.04	**<0.001**
Context of enrolment			
Outpatient clinic (reference)	–	–	
Hospitalized	1.58	0.77, 3.24	0.2

N included in modelling = 191. Significant p-values are highlighted in bold.
[a] OR = Odds Ratio, CI = Confidence Interval.

The need of mechanistic aid for walking had a two and a half time increase of odds to present AF compared to patients walking without aid (OR 2.57, CI:1.37–4.97, p = 0.004). Different hypotheses of the association between AF and gait impairment, walking impairment, leading eventually to falls could include HF related symptoms (dyspnea), sick sinus syndrome, pauses, chronotropic insufficiency due to rate control, disability secondary to precedent stroke, polypharmacy and irregular ventricular response and cardiac output. The weight of these eventual etiologies in the occurrence of walk impairment and falls in patients with AF should be further studied in prospective studies as this could significantly participate in multidimensional AF patient management.

By all, a lot of efforts are made to find the optimal medical treatment options of patients with AF such as the largely debated paradigm between rate control and rhythm control [36,37], systemic thromboembolic events prevention by anticoagulation, and treatment of secondary HF. In the light of evidence of associations between AF and geriatric syndromes, same efforts should be made to screen for frailty before development of multimodal functional decline. The prognosis of those syndromes and their subsequent impact on frailty, quality of life and life expectancy could be modified if taken in time.

Frailty markers and geriatric syndromes should also be systematically integrated in study outcomes regarding elderly patients with AF.

A main limitation of the study is its retrospective nature and inclusion of patients only in a hospital environment. AF diagnosis in the study participants was based on a single 12-lead ECG and past medical history which implies that prevalence and subclassification of type of AF can be biased. To understand if the above-mentioned associations can be maintained outside of hospitals (i.e. in the primary care), further prospective studies on the matter are warranted.

Another significant limitation of our study was the unbalanced representation of genders genders and and the absence of information about general racial distribution. This limitation together with the relatively small sample size of the population can have affected the generalizability of the study findings to other patient populations and might have precluded a more robust adjustment model with more relevant variables that could interact with frailty.

5. Conclusion

The present study provides evidence of an intimate association

between AF and Rockwood's Clinical Frailty Scale. Different geriatric syndromes were also associated with AF among which vascular dementia, malnutrition, functional dependency for ADL, mobility impairment and chronic ulcerous disease. Prospective studies are warranted in order to understand if the demonstrated association between AF, geriatric syndromes and frailty phenotypes could translate also in a causal relationship.

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CRediT authorship contribution statement

CdT and AS conceived the study design. CdT and TP were involved in data collection. CdT performed data statistical analysis. CdT, AS, PH, AdM, SM contributed to the data interpretation. CdT and AS wrote the original draft. SM, GC, CdA, AdM, and PH reviewed the manuscript for intellectual content.

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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