RESEARCH ARTICLE

Analysis of the effectiveness and the cost of hospitalization of patients with atrial fibrillation

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Abstract

Introduction: Hospitalizations of patients with atrial fibrillation (AF) lead to an explosion of expenditure on the public health system or private health expenses in family budgets. This study aims to estimate the duration and the cost of hospitalization for the public health system or the private cost to patients hospitalized after an AF episode.

Material and Methods: Two hundred thirty-five consecutive patients (141 men and 94 women with an average age of 71.91 ± 12.2 years) who presented with AF to the Emergency Department of the General Hospital of Veroia during a single year were studied. We assessed the possible causes of arrhythmia, the duration and outcome of hospitalization, and the cost of hospitalization. We estimated the total cost by adding the price of the drugs used to cardiovert and the money spent on the patient's hospitalization.

Results: The average hospitalization time was 2.37 ± 1.17 days, and the average cost of hospitalization (total cost) was € 488.22 ± 170.34. There was a significant correlation between the severity of the episode and the total cost (r =0.78, p<0.0001), with 87.6 % of the total cost (€ 427.76 ± 135.86) being related to the cost of hospitalization (imaging, laboratory, hospitalization) and the rest to the drug therapy cost. Amiodarone (97 patients, 41.1 %), flecainide (52 patients, 22 %), propafenone (68 patients, 28.8 %), vernakalant (two patients, 0.8 %), and quinidine (eight patients, 3.4 %) were utilized.

Conclusion: The average cost of hospital care in patients with AF is significantly related to the severity of the episode. Effective drug therapy to reduce AF-provoking factors, such as antihypertensive therapy, combined with cardiovascular disease prevention in general, could reduce the morbidity and costs of AF-related hospitalizations. HIPPOKRATIA 2023, 27 (1):18-21.

Keywords: Atrial fibrillation, management, hospitalization, cost, diagnosis-related groups, DRG

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Introduction

Atrial Fibrillation (AF) is the most common cardiac arrhythmia in the general population, with a prevalence of approximately 2 %[1] that is anticipated to increase to 2.7-3.3 % in the oncoming years due to the aging population[2-4]. AF is associated with increased mortality and morbidity due to complex complications and heart diseases[5,6].

It promotes thromboembolic events, especially strokes, with the risk being five times higher compared to patients without AF. In patients older than 65 years, 30 % of strokes are attributed to AF[7]. This complication constitutes one of the main causes of hospitalization in AF patients. In recent years, various studies have shown a dramatic increase in hospitalizations from AF to 30-32 %[8]. Based on epidemiological data, this hypothesis will continue to significantly impact the public health system's expenses[3]. A recent study demonstrated that AF patients hospitalization represents the maximum cost of managing the disease, almost 50-70 % of the total cost[9].

In Greece, limited data are available to determine the cost of hospitalization for AF[10]. The economic data on the disease are limited and challenging to implement. As a result, the costs associated with hospitalization are also significantly related to the funding of hospitals. Hospitals are reimbursed expenditures from the National Insurance based on the diagnosis-related groups (DRGs), a tool for measuring costs, benchmarking, and checking hospitals' effectiveness and efficiency. This system enhances transparency, cost documentation, measurement of the project produced, and a fairer allocation of resources according to activity-based funding[11].

This study aimed to estimate the duration and the cost of hospitalization for the public health system or the private cost for patients hospitalized after an AF episode.

Methods

We designed a cost-disease study. In Greece, health care provision is funded by the public, and patients have equal access to hospital services without reimbursing them. As a result, services related to hospitalization for AF, including antiarrhythmic drugs for cardioversion and

the costs of complications (bleeding, thromboembolic episodes, drug complications, etc.), are not charged to the patient. The study included 235 consecutive patients (141 men and 94 women with a mean age of 71.91 ± 12.2 years) who attended the Emergency Department of the hospital of Veroia with AF during a single year, from 1/8/2018 to 31/9/2019 and were managed by rhythm control strategy. The study protocol was approved by the Scientific Committee of the Hospital of Veroia (decision No: 68/2019), and all patients accepted and signed the informed consent.

Procedure

The diagnosis of AF was established by the electrocardiogram (ECG) (irregular RR intervals, absence of P waves) at the time of hospital admission. We obtained and recorded each patient's past medical history, physical examination, biochemical examination, thoracic X-ray imaging, and transthoracic echocardiography. Based on those results, the attending physician in the coronary care unit where the patient was monitored determined the appropriate medicinal or other option. The personnel monitoring the patients on a 24-hour basis confirmed conversion to sinus rhythm, which was documented by the ECG and stable sinus rhythm.

Efficacy and Outcomes

The patients were monitored for at least 36 hours, and the ECG documented the sinus rhythm steadily. If the drug was ineffective during that period, the patient was scheduled for electrical cardioversion or rate control. We assessed the possible causes of arrhythmia, the duration, outcome, and cost of hospitalization.

Evaluation of Costs

We estimated the cost according to the social security policy and divided it into the cost of hospitalization and medication. The total cost was calculated by summing the pharmaceutical expenditure for the AF cardioversion and the figures corresponding to patients' hospitalization, which comprised the reimbursement requested from the public health system or individual patients, depending on their insurance status. Hospitalization costs included diagnostic tests (echocardiography, Holter monitor, ECGs, exercise tests, etc.), therapeutic interventions (cardioversion), and hospitality services, which correspond to DRGs and specifically to X24X (for hospitalization <24 hours) and K46X (for hospitalization ≥24 hours). A single DRG was assigned to each inpatient management[12].

Analytically, the method of calculating the costs is reported in Table 1.

Statistical analysis

We analyzed data in three calculation stages: i) the hospitalization cost, ii) the costs of medications, and iii) the total cost. We checked for a normal distribution of the variables using the Kolmogorov-Smirnof test. We utilized the t-test to compare the mean values of quantitative variables with normal distribution. We tested and determined the relationship between quantitative variables, especially the cost of hospitalization and other parameters of cost evaluation by Pearson Correlation and Spearman Correlation for parametric and non-parametric variables, respectively. We set the level of statistical significance at 5 % (p <0.05) two-tailed. We performed all statistical analyses using the IBM SPSS Statistics for Windows, Version 19.0 (IBM Corp., Armonk, NY, USA).

Results
Baseline data - Study population

Table 2 lists the basic, epidemiological, and demographic data of the 235 AF patients (141 men and 94 women with a mean age of 71.91 ± 12.2 years) recruited in the study during its one-year duration. The leading underlying cardiac diseases associated with AF were hypertension in 107 patients (45.5 %), ischemic disease in 56 patients (23.8 %), valvulopathy in 31 patients (13.2 %), thyroid disease in 14 patients (6 %), and idiopathic in 27 patients (11.5 %). Table 2 comprises the AF causes according to patients' medical records.

Clinical outcomes - Conversion rates

Seventy-seven patients (32.7 %) successfully restored sinus rhythm; 66 (28 %) were cured medically, and 11 (4.7 %) were cardioverted. Amiodarone (97 patients, 41.1 %), flecainide (52 patients, 22 %), propafenone (68 patients, 28.8 %), vernakalant (two patients, 0.8 %), and quinidine (eight patients, 3.4 %) were utilized. The average hospitalization time was 2.37 ± 1.17 days.

Cost

The average cost of hospitalization was € 488.22 ± 170.34. There was a significant correlation between the severity of the episode and the total cost (r =0.78, p<0.0001; Figure 1), with 87.6 % of the total cost (€ 427.76 ± 135.86) being related to the cost of hospitalization (imaging, laboratory, hospitalization services) and

Table 1: Total cost estimation method summing the pharmaceutical expenditure and the figures corresponding to patients' hospitalization.

Medications cost		Hospitalization cost (DRG)	
Vernakalant	€ 338	**X24X**	<24h: € 177 + medication
Flecainide	€ 7.64	**K46X**	24h: € 444 + medication
Propafenone	€ 3.63		48h: € 444 + medication
Amiodarone	€ 1.57		72h: € 504 + medication
Quinidine	€ 1.12		>72h: € 504 + medication + € 60/day

DRG: Diagnosis Related Groups, X24X: hospitalization <24 hours, K46X: hospitalization >24 hours.

Table 2: Baseline data, epidemiological, and demographic characteristics of the 235 patients who presented with atrial fibrillation and were included in the study.

Gender (m/f)	141/94 (59.7/40.3)
Age (years)	71.91 ± 12.18
Duration of AF (hours)	16.7 ± 9.54
Symptomatic AF	93 (39.57)
Smoking	111 (47.23)
Underlying causes	
Hypertension	107 (45.5)
Ischemic disease	56 (23.8)
Valvulopathy	31 (13.2)
Thyroid diseases	14 (6)
Essential	27 (11.5)

Values are presented as means ± standard deviation or numbers with percentage in brackets. AF: atrial fibrillation, m: males, f: females.

Table 3: Cost estimation and factors that modulated the costs.

	n =235 patients
Efficacy-cardioversion	77 (32.7)
Hospitalization time (days)	2.37 ± 1.17
Total cost (€)	488.22 ± 170.34
Medication cost (€)	427.76 ± 135.86
Hospitalization cost (€)	5.86 ± 22.17

Values are presented as means ± standard deviation or numbers with percentage in brackets. n: number.

the rest with the cost of drug therapy. Table 3 lists the factors that modulated the costs.

Discussion

AF is the most common and important cardiac arrhythmia and a well-recognized cause of cardiovascular morbidity[1-3]. It is a consecutively increasing reason for hospital admissions with a specific economic burden on the health system[13]. Our study showed that the effectiveness of assaying to restore AF is 33 %. Recent randomized studies suggest that the efficacy of medicines in treating AF is 20-50 % compared to placebo[14-17]. Cardioversion of recent onset AF is always attempted to reduce the risk of embolic events and hemodynamic deterioration. Pharmaceutical intervention is preferred. The selection of the most suitable and effective drug is difficult, as well as the evaluation of effectiveness because the populations of the studies differ in meaningful parameters and characteristics, such as underlying heart disease (e.g. heart failure, coronary artery disease, etc.), duration of arrhythmia, dose and route of administration of the drug, follow up time, etc. Cardioversion is very effective when the drug administration begins within the first week of the onset of arrhythmia[16].

We estimated the average cost of hospitalization for the public health system at € 430, and this finding agrees with other recent or previous studies[9,18,19]. The average cost is significantly related to the severity of the AF episode, as expressed by the duration of hospitalization. This
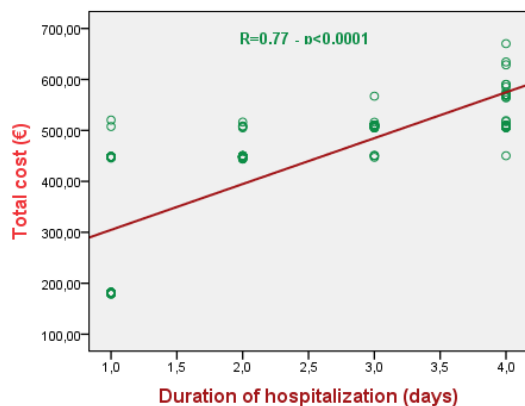

Figure 1: Graph showing a significant correlation between the severity of the episode, as declared by the duration of hospitalization, and the total cost.

finding is consistent with the findings of other studies[20].

The analysis of the total cost distribution presented that 97.6 % of this was associated with hospitalization costs (imaging examinations, laboratory, and hospitality services), as indicated by DRGs. The extension of the estimated cost of AF in the National Health System seems wide, reflecting the difficulty of determining the true cost in each case, especially if other comorbidities that could be the causes of AF (hypertension, cardiac insufficiency, valvular disease, etc) coexist. Considering all the above, a wise cost estimation is founded on the DRGs.

The DRG system accurately estimates each patient's hospitalization pricing, and hospitals are reimbursed with a revised and detailed hospitalization price list by grouping the diseases into categories and subdividing them into diagnostic categories with specified cost and average duration of hospitalization for each diagnostic group. The clinical practice showed positive points. The reimbursement is calculated more realistically, and the prices that hospitals are reimbursed for are closer to actual values. International and European experience has also shown that applying DRGs can support the auspicious operation of hospitals[21,22].

The current study showed that pharmaceutical cardioversion (or electrical) costs represent a weak or negligible percentage of the total cost. The cost of hospitalization is the most crucial component of the cost of AF. It competes or exceeds the cost of other medical conditions, such as depression, osteoporosis, breast cancer, etc. This agrees with the findings of other studies[23,9] and means that more assay must be assumed to manage or prevent the disease outside the hospital.

The 45.5 % of patients in the study were hypertensive. The high rate of hypertension in patients in our study is comparable to that of other studies[24,25]. Interestingly, such comorbidities can also be the reason for arrhythmia[26]. Many patients experience difficulty in regulating arterial hypertension, leading to diastolic dysfunction of the left ventricle, an increase in the dimensions of the left atrium, and electrophysiological remodeling[27]. Many studies have shown that hypertension is the most important modifiable element of AF, estimated at 25-30 % of all

causes of AF[24,28,29].

The study estimated the social security costs of patients who came to the hospital with AF, and an attempt was made to cardiovert. The number across Greece is estimated annually at 250,000 and will probably double over time. In the last twenty years, the number of hospitalized with AF has increased by 60 %[30]. Based on the data presented in this study, a larger-scale study regarding outpatient and inpatient populations could further investigate the benefits of reducing hospitalization costs in terms of the effect of the AF etiology and the drugs used for pharmacologic cardioversion of paroxysmal AF.

Limitations of the study

The study involved patients who attended the hospital solely for AF and not for other causes, where arrhythmia coexisted in the patient's pathology. Moreover, this conservative cost estimation was made according to the social security policy, while undoubtedly, the impact of AF costs is more significant.

Conclusion

The average cost of hospital care in patients with AF is significantly related to the severity of the episode. Of the total AF-patient cost, 97.6 % is associated with hospitalization costs. Effective drug therapy to reduce AF-provoking factors, such as antihypertensive therapy, combined with cardiovascular disease prevention in general, could reduce the morbidity and costs of AF-related hospitalizations.

Conflict of interest
The authors declare no conflicts of interest.

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