ORIGINAL ARTICLE

Breaking habits: safety and efficacy of elective electrocardioversion of atrial fibrillation and atrial flutter in the setting of day hospital

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ABSTRACT

Aim To examine safety and efficiency of electrocardioversion (EC) in elective treatment of atrial fibrillation and atrial flutter in the setting of Day Hospital by determining success rate, frequency of adverse events and possible cost benefit compared to admitting a patient into hospital.

Methods This prospective observational cohort study was performed in Day Hospital and in Intensive Care Department of Internal Medicine Clinic, University Clinical Centre Tuzla from January 2019 to December 2022 and included 98 patients with a persistent form of atrial fibrillation (AF) or atrial flutter. The patients ~~who~~ were divided in two groups, 56 hospitalized and 42 patients accessed in Day Hospital. In all patients, medical history, physical examination, electrocardiogram (ECG) and transthoracic echocardiogram (TTE) evaluation was performed in addition to laboratory findings. Electrocardioversion was performed with a monophasic General Electric defibrillator in anterolateral electrode position with up to three repetitive shocks.

Results In hospital setting group overall succes rate of electrocardioversion was 85%, with average 2.1 EC attemps, ~~there was~~ with one fatal outcome due to stroke, one case of ventricular fibrillation (VF) due to human error, and 6 minor adverse events; ~~with~~ average cost ~~of~~ was 1408.70 KM (720.23 €) per patient. In Day Hospital setting succes rate was 88%, with average 2 EC attempts, no major adverse events, 8 minor adverse events; ~~and~~ average cost was ~~of~~ 127.23 KM (65.05 €) per patient.

Conclusion Performing elective electrocardioversion in Day Hospital setting is as safe as admitting patients into hospital but substantially more cost effective.

Key words: adverse events, cost benefit analysis, electrocardiography, Intensive care unit

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INTRODUCTION

Atrial fibrillation (AF) and atrial flutter are most common supraventricular tachycardias found in clinical practice with enormous burden worldwide due to high rates of morbidity, disability and mortality (1). The global prevalence of AF has increased substantially over the past three decades and there are currently approximately 60 million cases worldwide (2). AF is associated with increased risk of developing stroke, systemic embolism, and heart failure (3). Patients are rarely asymptomatic; they exhibit various symptoms ranging from chest pain, palpitations, shortness of breath, dizziness to generalized fatigue and malaise (4). Commonly these symptoms affect patients' quality of life (5). European Heart Rhythm Association (EHRA) established classification based on the impact of the symptoms on daily activities during episodes of AF: EHRA class I is asymptomatic patient, class II exhibit mild symptoms, class III severe symptoms, and ~~while~~ class IV is reserved for disabling symptoms preventing patients from any daily activity (6).

Atrial flutter is characterized by an abnormal cardiac rhythm that is fast with an atrial rate of 300 beats/min and a ventricular rate that can be fixed or variable and causes palpitations, fatigue, syncope, and embolic phenomenon (7). The prevalence of AF is about 1–3% in the general population but rises with age (up to 9% aged ≥65 years; up to 17%, ≥80 years), and it is more common in men than in females (8). Adequate nationwide statistical data regarding prevalence of AF in Bosnia and Hercegovina is lacking. It is estimated that in Bosnia and Herzegovina about 5.47% of adults have AF (9). The frequency of atrial flutter is lower compared to the frequency of AF, and its incidence is 5/100,000 people younger than 50 years old, or up to 600/100,000 in people older than 80 years old (10). In the USA, about 200,000 new cases are registered per year (11). There is a heightened occurrence of AF and atrial flutter in the milieu of thyroid dysfunction, heart failure and cardiomyopathy, valvular heart defects, cardiac surgery, aortic dissection, congenital heart defects, diabetes, coronary artery disease, obesity, hypertension, chronic kidney disease, chronic obstructive pulmonary disease etc (12).

AF and atrial flutter are diagnosed mainly based on electrocardiogram (ECG) characteristics. Diagnosis of AF requires documented episode of AF lasting >30 s and recorded by 12-lead or a single lead ECG. In case of infrequent episodes, long-term recordings using Holter monitors are mandatory (13). Treatment strategy includes either anticoagulation therapy and control of ventricular rate or restoration of sinus rhythm by pharmacological or electrical cardioversion (14). Transthoracic electrocardiovesion (EC) is an emergency or elective interventional procedure to attempt to restore sinus rhythm with synchronized transthoracic defibrillator shock (15). As an emergency procedure for AF and atrial flutter, it is performed in case of hemodynamically compromised patient. Elective EC is a planned procedure with prior assessment of the patient's benefits, anticoagulant therapy and/or supportive antiarrhythmic therapy, which post-conversion serves to maintain a restored sinus rhythm (16). For AF and atrial flutter that last more than 48 hours or unknown duration, antivitamin K anticoagulant preparation during 3 weeks is necessary with the achievement of the target INR (~~English~~ International Normalized Ratio) between 2 and 3 (17).

The aim of this study was to examine safety and efficiency of electrocardioversion in elective treatment of AF and atrial flutter in the setting of Day Hospital by determining success rate, frequency of adverse events and possible cost benefit compared to admitting a patient into hospital.

PATIENTS AND METHODS

Patients and study design

This prospective observational cohort study was performed in Day Hospital and Intensive Care Department of Internal Medicine Clinic, University Clinical Centre Tuzla from January 2019 to December 2022 and included 98 patients with a persistent form of AF or atrial flutter. The patients were divided in two groups: first group of 56 patients in whom electrocardioversion was performed in hospital setting, and second group of 42 patients in whom electrocardioversion was performed in the setting of Day Hospital.

A comparison was made between these two groups of patients in terms of evaluating the success and the safety of electrocardioversion. Safety was assessed by the prevalence of adverse events during 30 days after EC (early and late complications

- rhythm and conduction disorders, hemorrhagic and thromboembolic incidents, hemodynamic instability). Successful electrocardioversion is defined by restored sinus rhythm until discharge.

Inclusion criteria were: persistent form of non-valvular AF and atrial flutter which lasted longer than 48 hours and up to three years, CHA2DS2 - VASc score <5, left atrial size <5.5 cm, age up to 75 years, symptomatic EHRA class <4.

Exclusion criteria were: patients older than 75 years, left atrial size >5.5 cm, patients with significant left ventricular dysfunction (ejection fraction <35%), with thyroid gland dysfunction, significant chronic obstructive pulmonary disease, active alcoholism, severe anemia and patients with a positive history of stroke and unregulated arterial hypertension of the third degree.

An informed consent was obtained from all patients following an explanation of the purpose of the study. An ethical approval was obtained from the Ethical Committee of the University Clinical Centre Tuzla.

Methods

Duration of AF and atrial flutter was established using history and medical documentation evaluation. In all patients, an electrocardiographic (ECG) and transthoracic echocardiogram (TTE) evaluation was performed with measurement of the systolic function of the left ventricle and left atrium in M and 2D mode. In all patients comorbidities and risk factors were analyzed, and laboratory findings were performed: blood count, electrolytes, creatinine, INR, hormonal status of the thyroid gland (T3, T4, TSH), glucose and iron levels in order to exclude possible secondary causes of arrhythmia that may affect success rates. Three weeks before the procedure, patients were treated with an oral antivitamin K anticoagulant drug in order to achieve an optimal INR (2-3), antiarrhythmics (amiodarone or propafenone with/or without beta-blockers or non-dihydropyridine calcium channel antagonists), with the aim of continuing supportive antiarrhythmic therapy after electrocardioversion.

The patient follow up was on the 7th day, then in a month. Electrocardioversion procedure is fully compliant with the existing hospital policy. All patients were instructed to fast (not eat or drink anything) at least 6 hours before procedure. Prior to procedure all patients underwent short-term hypnotic sedation with midazolam in an average dose of 7.5 mg. Synchronous electrocardioversion was performed up to 3 repetitive shocks (200J, 300J, 360J) with continuous monitoring for at least four hours until discharge. Electrocardioversion was declared unsuccessful after the inability to establish sinus rhythm after three successive synchronous shocks. Electrocardioversion was performed with a monophasic General Electric defibrillator and anterolateral electrode position.

Statistical analysis

Data was processed and presented through descriptive statistics, using measures of central tendency and dispersion. Quantitative variables were analyzed using Student's t-test, for variables that were normally distributed, while for non-parametric variables, a non-parametric alternative was used. Related variables were compared by paired t-test. Categorical variables were analyzed with the chi-square test, or Fisher's test for frequencies below 5. Connections between variables were tested with parametric and non-parametric correlation. All analyzes were performed with a statistical probability level of 95% ($p<0.05$).

RESULTS

Total of 98 patients met inclusion criteria. They were divided into two groups, 56 hospitalized patients and 42 patients in Day Hospital setting (Table 1). In the group of 56 hospitalized patients who underwent electrocardioversion of atrial flutter and AF; males were predominanted, 43 (76.8%) and 13 (23.2%) females. The average age of patients was 58±6 years.

AF was more prevalent rhytm disorder, in 45 (80%), and atrial flutter in 11 (20%) patients. Succesiful electrocardioversion with restauration of sinus rhytm was noted in 48 (out of 56) patients resulting in succes rate of 85%. In eight patients it was impossible to restore the sinus rhytm after 3 succesive schocks using appropriate increase in delivered energy. The average converting schock energy per patient was 575 J or 2.1 electroconversion attempts. Among the adverse events, there was one fatal outcome where patient had ischaemic stroke on the third day after successful electrocardioversion. His risk factors and comorbidities did not differ significantly

Table 1. Demographic data, medical history, and observed outcomes of the study patients

Variable	Hospitalized patients (n=56)	Day Hospital patients (n=42)	p
Age (years)	58±6	57±5	0.189
Males (No, %)	43 (76.8)	34 (80.0)	0.618
Body mass index (kg/m2)	30.2 ± 2.9	29.5 ± 2.4	0.749
Comorbidities and risk factors (No, %)			
Hypertension	25 (44.6)	16 (38)	0.735
Diabetes mellitus	43 (76.7)	34 (80.9)	0.613
Current smoker	31 (55.3)	22 (52.3)	0.842
Hyperlipidaemia	39 (69.6)	31 (73.8)	0.317
Atrial fibrillation	45 (80.0)	32 (76.0)	0.302
Atrial flutter	11 (20.0)	10 (24.0)	0.279
Electrocardioversion success rate (n [%])	48 (85.0)	37 (88.0)	0.418
Average converting energy (J)	575 ± 26.15	522 ± 52.92	0.281
Electrocardioversion attempts	2.1 ± 0.54	2.0 ± 0.49	0.374
Adverse events (No, %)			
Ischemic stroke	1 (1.7)	0	0.122
Ventricular fibrillation	1 (1.7)	0	0.173
Benign rhythm disturbances	6 (10.7)	8 (19.0)	0.539
Average cost KM (EUR)	1408.70±401.32 (720.23)	127.23±14.56 (65.05)	<0.001

J, Joule (unit of energy delivered during electrocardioversion); KM, convertible mark, the currency of Bosnia and Herzegovina; EUR, euro, the official currency of the European Union

compared to other patients. There was one case of ventricular fibrillation without consequences due to inadequate synchronization. In six patients insignificant rhythm disturbances in the sense of transient sinus bradycardia and extrasystole was recorded. The average duration of hospitalization was 4.4 days, with an average cost of 320.16 KM (163.69 €) per day in Intensive care department, totaling to 1408.70 KM (720.23 €) per patient.

In the group of 42 patients who underwent electroconversion in Day Hospital setting there were also predominantly males, 34 (80%) and eight (20%) female. The average age in this group was 57±5 years. Main rhytm disorder was AF, in 32 (76%), atrial flutter in 10 (24%) patients. Succes rate of electrocardioversion in this group was 88%, with 37 patients with succesiful sinus rhytm restorations and five patients where attempts to restore the sinus rhytm failed. Average converting energy was 522 J and 2 electrocardioversion attempt. Major adverse events were not observed, there was no hemorrhagic and thromboembolic incidents or hemodynamic instability. In eight patients sinus bradycardia and isolated (transitory) extra systoles was observed. No adverse events in the observed period after discharge were noted. Cost of the electrocardioversion procedure in Day Hospital setting was 127.23 KM (65.05 €) per patient.

DISCUSSION

Our study demonstrated safety and efficiency of electrocardioversion for treatment of AF and atrial flutter regardless of setting where it was performed. Due to fear of potential adverse events following electrocardioversion therapy, in many hospitals in B&H and worldwide this procedure is still performed as an inpatient procedure which in turn has major implications for health care resources (18). Systematic data concerning efficacy and, more importantly, the safety of procedure in Day Hospital setting in B&H and surrounding countries are lacking. Demographic charachteristics of both groups were simmilar. AF and atrial flutter were more prevalent in males which is simmilar to numerous other studies (19). Prevalence of AF is lower in younger females due to hormonal protective role in the reproductive years compared to men, but after 75 years of age paradoxically prevalence of AF is greater in females since on average they live longer than men and also due to hormonal changes after menopause (20). The patients over the age of 75 were excluded in our study, therefore gender difference where males were predominant may be attributed to inclusion criteria. Success rate of electrocardioversion in our study was 85%, and 88% in in hospital setting and in Day Hospital, respectively. Interestingly, Neumann et al. found much higher success rate using biphasic waveform, 100% for the biphasic and 73.7% for the monophasic waveform; biphasic patients required fewer shocks (1.5 versus 2.9) and a lower mean cumulative energy (203 versus 570 joules) (21). However, Scholten et al. found that protocol using monophasic waveform shocks in a 200–360 J sequence had the same efficacy (90%) as a protocol using biphasic waveform shocks in a 120–200 J sequence, but this equal efficacy is achieved with a significantly lower mean delivered energy level using biphasic shock waveform (22). Our study found that mean number of shocks delivered to establish sinus rhytm was 2.1 for hospitalised and 2 shocks for Day Hospital patiens. Current guidelines favor using biphasic shock waveform (23). In our study we used monophasic waveform shocks due to lack of funding for newer, better quality biphasic defibrillators. While it is understandable that funding for healthcare equipment can be limited worldwide, this is common issue

in various healthcare institutions in Bosnia and Herzegovina and surrounding countries (24).

Few adverse events were noted in our study, more frequently in hospitalized patients than in Day Hospital setting. In Day Hospital setting there was not a single casse of serious adverse events observed. Therefore, safety of electrocardioversion in Day Hospital setting was comparable to hospital setting atributted probably to human factor and tehnique of preforming the procedure rahter then setting itself. Other studies also support safety of electrocardioversion in Day Hospital setting. Fried et al. concluded that electrical cardioversion followed by discharge home in Emergency Department was largely safe and effective with most complications transient and mild (25).

The outcomes of our study displayed considerable cost benefit choosing the Day Hospital setting for the procedure. It is different comparing to other studies where Day Hospital setting electrocardioversion and discharge is dramatically more cost effective compared with management approaches requiring hospital admission and observation (26).

Limitations of this study include the observational study design and a relatively small sample size due to COVID-19 pandemic restrictions during study period affecting number of elective procedures performed. Nevertheless, a notable advantage of the study is that we obtained data and conclusions that we can impliment in our future daily routines and studies regarding this topic in Bosnia and Herzegovina are lacking. Moreover, the prospective nature of our study allowed systematic collection of patient data. The study indicates importance of breaking longstanding habits in performing certain procedures.

In conclusion, efficiency in achieving sinus rhythm between two groups of patients was comparable, as well as presence of adverse events which were few and mostly transient, with significant cost benefit of performing electrocardioversion in Day Hospital setting. This study did not find a single argument to continue vastly present practice of admitting patients for performing this procedure.

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TRANSPARENCY DECLARATION

Conflicts of interest: None to declare.

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