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RESEARCH ARTICLE

ELECTRICAL CARDIOVERSION PROPERTIES WHICH IMPACT PROCEDURE EFFECTIVENESS IN PATIENTS WITH LONG-ACTING ATRIAL FIBRILLATION

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ABSTRACT

Atrial fibrillation is the most common cardiac arrhythmia. Atrial fibrillation is characterized by high morbidity and mortality. Electrical or pharmacological cardioversion is a standard procedure to restore sinus rhythm. Aim was to evaluate the correlation between the amount of electrical shocks as well as the total energy applied with maintenance of sinus rhythm 30 days after electrical cardioversion. In this prospective study data from 150 patients were collected in Pauls Stradins Clinical University Hospital`s. Questionnaires were administered and follow-up data were collected by phone patient survey from 30 days after ECV.150 patients were questioned – 70% male (n=105) and 30% female (n=45) with a mean age of 65 (56-74) years. Electrical cardioversion was performed to all patients in this study. Sinus rhythm was restored in 145 of patients (96.7%). The success rate after a single discharge was 87.3%. 2 electrical shocks were required for 9.3% of patients and 3.3% of patients benefited from a third shock. A single discharge has a greater success rate for maintaining sinus rhythm for 30 days (p=0.003). In 10% of all patients cardioversion began with 150 J. Initial discharge was 200 J for 76.7% of patients, the total energy applied was 300 J for 6% of patients and 360 J for 3.3% of patients. The success rate for maintaining sinus rhythm for 30 days was greater with higher initial discharges (p=0.004). A successful single discharge and higher total energy applied correlate with more stable sinus rhythm 1 month after electrical cardioversion was performed.

INTRODUCTION

Atrial fibrillation (AF) is the most frequent arrhythmia, with a prevalence of 5% in patients over 65 years and an incidence that increases with age (Masiaa 2001).

Death due to stroke can largely be mitigated by anticoagulation, while other cardiovascular deaths, for example due to heart failure and sudden death, remain common even in AF patients treated according to the current evidence base (Kotecha 2014). In 2010, the estimated numbers of men and women with AF worldwide were 20.9 million and 12.6 million, respectively, with higher incidence and prevalence rates in developed countries. By 2030, 14-17 million AF patients are anticipated in the European Union, with 120 000-215 000 newly diagnosed patients per year (Colilla 2013). Atrial fibrillation leads to irregular and inappropriate ventricular rates causing symptoms and predisposing to potentially life-threatening thromboembolic complications (Stewart 2002). Electrical cardioversion is effective in converting patients to sinus rhythm in the emergency department setting (Burton 2004), but the recurrence of AF is common.

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Cardioversion also exposes patients to thromboembolic and arrhythmic complications (Pisters 2012).

The aim of the article isto evaluate the correlation between the amount of electrical shocks as well as the total energy applied with maintenance of sinus rhythm 30 days after electrical cardioversion.

MATERIAL AND METHODS

In this prospective study data from 150 patients were collected in Pauls Stradins Clinical University Hospital`s Department of Arrhythmology which holds information about patients who had undergone electrical cardioversion to restore sinus rhythm. Questionnaires were administered and follow-up data were collected by phone patient survey from 30 days after ECV.

Data were processed using SPSS 20.0 software, $p<0.05$ was considered statistically significant.

RESULTS

150 patients were questioned - 70% male (n=105) and 30% female (n=45) with a mean age of 65 (56-74) years. Electrical

cardioversion was performed to all patients in this study. Sinus rhythm was restored in 145 of patients (96.7%).

Only 51 patient, who had sinus rhythm in 30 days of follow-up, underwent electrical cardioversion for the first time, 28 patients did it for the second time and 23 patients had done it at least 3 times or more. (Table 1.)

Table 1 Number of ECVs performed in patients, who had sinus rhythm in 30 days of follow-up.

		Frequency	Percent
Number of ECVs	1-1	51	45.9
	2-2	28	25.2
	3->3	23	20.7

For the first time ECV was performed in 24 patients, who had atrial fibrillation in 30 days of follow-up, for the second time in 6 patients and 9 patients underwent electrical cardioversion for the third time or more. (Table 2.)

Table 2 Number of ECVs performed in patients, who had atrial fibrillation in 30 days of follow-up.

		Frequency	Percent
Number of ECVs	1-1	24	61.5
	2-2	6	15.4
	3->3	9	23.1

The success rate after a single discharge was 87.3%. 2 electrical shocks were required for 9.3% of patients and 3.3% of patients benefited from a third shock. A single discharge has a greater success rate for maintaining sinus rhythm for 30 days (p=0.003). (Table 3.)

Table 3 Count of discharges during ECV in patients who had sinus rhythm or atrial fibrillation in 30 days of follow-up.

		Sinus rhythm after 30 days of follow-up		AF after 30 days of follow-up	
		Frequency	Percent	Frequency	Percent
Count of discharges during ECV	1 discharge	102	91.9	29	74.7
	2 discharges	8	7.2	6	15.4
	3 discharges	1	0.9	4	10.3

In 12 (10.8%) patients, who had sinus rhythm after 30 days follow-up, cardioversion began with 150 J. Initial discharge was 200 J for 90 (81.1%) patients, who had sinus rhythm after 30 days follow-up, in 3 (2.7%) patients the total energy applied was 250 J, in one patient (0.9%) it was 270 J, in 4 (3.6%) patients it was 300 J and the total energy applied was 360 J for 1 (0.9%) patient. In 3 (7.7%) patients, who had atrial fibrillation after 30 days follow-up, cardioversion began with 150 J. Initial discharge was 200 J for 25 (64.1%) patients, who had atrial fibrillation after 30 days follow-up, in 1 (2.6%) patients the total energy applied was 250 J, in one patient (2.6%) it was 270 J, in 5 (12.8%) patients it was 300 J and the total energy applied was 360 J for 4 (10.3%) patient. The success rate for maintaining sinus rhythm for 30 days was greater with higher initial discharges (p=0.004). (Table 4.)

Table 4 Energy applied during ECV in patients who had sinus rhythm or atrial fibrillation in 30 days of follow-up.

		Sinus rhythm after 30 days of follow-up		AF after 30 days of follow-up	
		Frequency	Percent	Frequency	Percent
Energy applied during ECV (J)	150	12	10.8	3	7.7
	200	90	81.1	25	64.1
	250	3	2.7	1	2.6
	270	1	0.9	1	2.6
	300	4	3.6	5	12.8
	360	1	0.9	4	10.3

DISCUSSION

The amount of energy needed for initial attempts of direct current cardioversion has been controversial. Once satisfactory synchronisation is obtained, sedation or anaesthesia is initiated, and a shock is delivered. After shock delivery, if conversion is unsuccessful, higher energy repeat direct current cardioversion is attempted. This can be repeated until the arrhythmia terminates or the decision is made to abandon direct current cardioversion (Ricard 1997).

Higher biphasic energies as a first direct cardioversion shock for patients who are overweight or have a higher transthoracic impedance might be recommended. The Best-AF trial demonstrated that, when biphasic waveforms were used, there was a significant increase in the first-shock success for direct current cardioversion if the initial energy selected was 200 J rather than 100 J. In patients who were overweight or obese, first-shock success was significantly greater if a higher-energy shock was selected. However, in patients with a normal or low body mass index there was no difference in the first-shock success regardless of whether 100 J or 200 J was used. (Glover 2008).

Despite its widespread clinical use, controversy surrounds the electrophysiologic mechanisms by which direct current cardioversion terminates atrial fibrillation involving multiple microreentrant circuits. Most investigators agree that defibrillation occurs when a certain amount of current density reaches the myocardium. However, it is unclear what amount of current density is needed and what energy setting is necessary to achieve homogeneous current density. Complications associated with direct current cardioversion are mainly risks related to general anaesthesia, thromboembolic events and postcardioversion arrhythmias (Stellbrink 2004). For persistent AF, an initial energy of 200 J is recommended for biphasic defibrillators, and 300 to 360 J are recommended for monophasic defibrillators, with the electrodes placed in the anterior posterior position. For refractory cases, alternatives are available such as dual defibrillators or internal cardioversion. Antiarrhythmic drugs may enhance the results of cardioversion by helping overcome shock failure or by preventing immediate recurrence of AF (Joglar 2004).

CONCLUSIONS

Electrical cardioversion is a standard procedure and is very effective in the treatment of atrial fibrillation. It has a high rate of success in restoring sinus rhythm. A successful single discharge and higher total energy applied correlate with more stable sinus rhythm 1 month after electrical cardioversion was performed. The longer atrial fibrillation exists, or the more persistent it becomes over time, the harder it is to treat it.

When cardioversion fails, shocks can be repeated at highest energy until the arrhythmia terminates or a decision is made to abandon direct current cardioversion. Repositioning the paddles should also be done in case of failure. Furthermore, the double-paddle technique is another alternative as well as pharmacologic facilitation of cardioversion: in one study, patients who had AF and had failed 360-J monophasic cardioversion were loaded with amiodarone orally. If repeat 360-J monophasic cardioversion persisted in failing, the patients underwent the double-paddle technique: two monophasic defibrillators were used with two sets of paddles for each patient; each defibrillator was set for a synchronous shock at the maximum output of 360 J; they then were discharged simultaneously, resulting in successful conversion of 13 out of 15 patients (Kabukcu 2004).

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