2014•2015

FACULTEIT GENEESKUNDE EN LEVENSWETENSCHAPPEN

master in de biomedische wetenschappen

Masterproef

Patient Education as an Important Factor in the Management of Atrial Fibrillation by Improving Self-Management Activities

Promotor :
Prof. dr. Virginie BITO

Copromotor :
Prof. dr. Lars GRIETEN

Promotor :
Prof. Dr. DIETER NUYENS

Pauline Dreesen

Scriptie ingediend tot het behalen van de graad van master in de biomedische wetenschappen

2014•2015
FACULTEIT GENEESKUNDE EN LEVENSWETENSCHAPPEN
master in de biomedische wetenschappen

Masterproef

Patient Education as an Important Factor in the Management of Atrial Fibrillation by Improving Self-Management Activities

Promotor :
Prof. dr. Virginie BITO

Copromotor :
Prof. dr. Lars GRIETEN

Promotor :
Prof. Dr. DIETER NUYENS

Pauline Dreesen

Scriptie ingediend tot het behalen van de graad van master in de biomedische wetenschappen

universiteit hasselt | Maastricht University

Acknowledgements

Performing a senior internship and writing a thesis is far but a one man mission. First of all, I would like to thank Hasselt University and Ziekenhuis Oost-Limburg (ZOL, Genk) for giving me the opportunity to perform my senior master training at the department of Cardiology, Arrhythmology and Electrophysiology for a period of eight months.

Special thanks to my promotor Prof. Dr. Dieter Nuyens for finding the time in your busy schedule in providing me positive, critical feedback and for learning me all the ins and outs of atrial fibrillation. It was been a pleasure working with you throughout these eight months. Another great man deserves another big thanks; Prof. dr. Lars Grieten, thank you for your guidance and your help in getting my project on track, especially during the first months. Also thank you for reading and commenting on my thesis.

I would also like to thank Dr. Hugo Van Herendael, Dr. Maximo Rivero-Ayerza, Phillipe Jansen, and Eline Moors for your help and comments in developing the AF and DCC booklets, together with Dr. Nuyens. Also a word of appreciation to all the cardiologists for the support during my internship. Another big thanks to all the nurses and doctors of the CPU and CCU unit for letting us know when an electrical cardioversion would be performed. Which brings me to the next round of many thanks to all the AF patients who participated in this study and made this research possible. Furthermore, special thanks to Linda Jacobs for teaching me how to deal with patients and how to provide patient education.

Many thanks to my institutional supervisor Prof. dr. Virginie Bito and my second examiner dr. Vesselina Ferferieva for finding the time to listen and critically discuss my progress.

Also thanks to the PhD students at ZOL for their advice and support. A special word of thanks to Christophe Smeets, for the all the laughter and 'positive' stress moments and for never letting us forget about the deadlines!!;-)

Finally a thank you to all my fellow students at ZOL for their direct and indirect help: Catherine, Kirsten, Hélène, Levinia, Tiziana, Thomas, Maxim, Elke, Ann, Robby & Shamaila. Without you guys this master training would have never been that fun! I will never forget our runtastic moments and participation at Genk Loopt, those magical Mondays, our claustrophobic elevator moments, lying-in-the-grass-and-searching-for-four-leaf-clovers (and finding them!), and the moment when Catherine broke the Frisbee. Thank you my minions!

Last but definitely not least, very special thanks to my parents and boyfriend for all the opportunities you gave me, for listening to my stressy moments, and your continuous support and believe!

List of abbreviations

ACC/AHA/ESC	the American College of Cardiology, American Heart Association, and European Society of Cardiology
ACE-I	Angiotensin-converting-enzyme inhibitor
AF	Atrial Fibrillation
ARB	Angiotensin II receptor blocker
AV node	Atrioventricular node
BMI	Body mass index
BP	Bodily pain
Bpm	Beats per minute
CAA	Calcium antagonist
CAD	Coronary artery disease
CCU	Coronary Care Unit
CH	Change in health
CHA_2DS_2-VASc score	Congestive Heart Failure, Hypertension, Age 75 years or older, Diabetes mellitus, previous Stroke /transient ischemic attack/thromboembolism, Vascular disease, Age between 65 and 74 years, and Female Sex
CNS	Clinical nurse specialist
COPD	Chronic obstructive pulmonary disease
CPU	Chest Pain Unit
DCC	Direct-current cardioversion
DM	Diabetes Mellitus
ECG	Electrocardiogram
ECV	Elektrische cardioversie
EHRA score	European Heart Rhythm Association score of AF-related symptoms
GH	General health
HAS-BLED score	Uncontrolled Hypertension, Abnormal renal/liver function, Stroke, Bleeding history or predisposition, Labile International Normalized Ratio, Elderly >65 years, Drugs/alcohol concomitantly
HF	Heart failure
IKA	Interkwartielafstand
INR	International Normalized Ratio
IQR	Interquartile range
LAA	Left atrial appendage
LMWH	Low-molecular weight heparin
LV	Left ventricular
LVEF	Left ventricular ejection fraction
MH	Mental health
MI	Myocardial infarction
MMAS	The Morisky's self-reporting, medication taking-adherence scale
n	Sample size
NOAC	Novel oral anticoagulants for atrial fibrillation
OSAS	Obstructive sleep apnea syndrome
P	P-value
PC	Pharmacological cardioversion
PF	Physical functioning
Q	Question number
R^2	Correlation coefficient
RE	Role limitations due to emotional problems
RP	Role limitations due to physical health problems
SA node	Sinoatrial node
SD	Standard deviation
SF	Social functioning
SF-36	Dutch Medical Outcomes Study 36-Item Short Form Survey Instrument
TE	Thromboembolism
TEE	Transoesophagal echocardiography
TIA	Transient ischemic attack
TICM	Tachycardia-induced cardiomyopathy
VHD	Valvular heart disease
VKF	Voorkamerfibrillatie
VT	Vitality
ZOL	Ziekenhuis Oost-Limburg

Abstract

Introduction: Direct-current or electrical cardioversion (DCC) is a therapeutic strategy commonly performed in patients with paroxysmal or persistent atrial fibrillation (AF). Despite its high success rate, recurrence of AF is often the case. Insufficient self-management activities, due to lack of important patient knowledge of AF, may even trigger this relapse or delay its detection. This strongly increases the risk of developing AF-related complications, such as stroke. We therefore hypothesized that providing education to AF patients undergoing DCC will enhance their knowledge about their condition and subsequently improve their contribution in self-management activities. This may eventually lead to a faster detection of AF recurrence after successful DCC.

Subjects & methods: 42 AF patients who would undergo DCC were randomly assigned to receive either patient education (n=21) or usual care (n=21). Successful DCC was defined as a stable sinus rhythm >1h following the cardioversion procedure. Patient's knowledge of AF, knowledge of DCC, attitude regarding AF, self-management activities, and quality of life were assessed at baseline and follow-up by using questionnaires. Mean follow-up duration was 4.62 ± 1.65 weeks. The educational intervention consisted of verbal information accompanied by information booklets about AF in general and DCC in particular. Patients were also instructed about the importance of medication compliance and lifestyle changes in response to their AF condition. A P-value <0.05 was considered a statistically significant difference.

Results: DCC showed a success rate of 90%, but recurrence of AF occurred in 30% of the patients. After receiving education, a significant increase was seen in patient's overall knowledge of AF (69.23% (IQR 11.53) pre- vs. 84.62% (IQR 19.24) post-education, P=0.011) and their contribution in self-management roles (77.78% (IQR 22.22) vs. 88.89% (IQR 16.66), P=0.031). In addition, more patients were aware of the importance of monitoring their pulse regularly in order to detect asymptomatic AF episodes in an early stage. No significant changes were observed in the overall knowledge levels and self-management activities of patients in the control group between baseline and follow-up. However, their attitude towards AF had decreased (87.50% (IQR 8.75) at baseline vs. 80% (IQR 8.75) at follow-up, P=0.043). Patient's quality of life was not significant different between baseline and follow-up for all 42 AF patients, but their EHRA score showed a significant shift towards a class I score (no symptoms) post-DCC (P<0.001).

Discussion & conclusions: This study showed that providing education to AF patients undergoing DCC increases their knowledge of their condition as well as their contribution in self-management activities. However, recurrence of AF post-DCC was not detected faster in patients who received education, since they were not instructed to monitor their pulse several times a day. Patients who do not receive proper education regarding AF might not consider AF a serious disease anymore once they underwent successful DCC. This may lead to low medication compliance and a risk for stroke. Future studies are needed in order to determine whether patient education in combination with a daily self-pulse examination protocol may lead to a faster detection of AF recurrence after successful DCC.

Samenvatting

Inleiding: Elektrische cardioversie (ECV) wordt vaak geopteerd als behandelingsoptie van paroxysmale of persistente voorkamerfibrillatie (VKF). Ondanks zijn hoge doeltreffendheid, komt herval van VKF vaak voor. Daarnaast kan onvoldoende zelfmanagement, door gebrek aan kennis over VKF, dit herval uitlokken of de detectie ervan uitstellen. Dit heeft als gevolg dat de patiënt een verhoogd risico heeft op het ontwikkelen van complicaties, zoals bijvoorbeeld een beroerte. Daarom veronderstellen wij dat het voorzien van educatie aan VKF patiënten die ECV als behandeling zullen krijgen hun kennis omtrent hun aandoening zal verhogen, wat vervolgens zal resulteren in een verbetering van hun zelfmanagement. Dit zou uiteindelijk kunnen leiden tot een snellere detectie van herval van VKF na een succesvolle ECV.

Patiënten & methoden: 42 VKF patiënten die ECV zouden ondergaan, werden willekeurig onderverdeeld in de educatie groep (n=21) of de controle groep (n=21). De ECV werd als succesvol beschouwd wanneer een stabiel sinus ritme voor meer dan een uur na de cardioversieprocedure bekomen werd. Aan het begin van de studie en na een gemiddelde periode van 4.62 ± 1.65 weken, werd de kennis van de patiënten omtrent VKF en ECV, alsook hun attitude en zelfmanagement activiteiten geëvalueerd aan de hand van vragenlijsten. De educatie omvatte verbale informatie en brochures over VKF en ECV. Veel belang ging naar therapietrouw en levensstijladaptatie. Een P-waarde <0.05 werd als een statistisch significant verschil beschouwd.

Resultaten: De ECV had een doeltreffendheid van 90%, maar herval trad op in 27.8% van de totale studiepopulatie. De educatie resulteerde in een verhoging van de algemene kennis van patiënten omtrent VKF (69.23% (IKA 11.53) pre- vs. 84.62% (IKA 19.24) post-educatie, P=0.011), alsook een verbetering van hun zelfmanagement activiteiten (77.78% (IKA 22.22) vs. 88.89% (IKA 16.66), P=0.031). De patiënten waren ook meer bewust van het belang van het regelmatig controleren van hun pols/hartslag om asymptomatische VKF episodes in een vroeg stadium op te sporen. Deze verschillen werden niet gezien voor patiënten in de controlegroep, maar hun attitude omtrent VKF was wel verlaagd na een follow-up van vier weken (87.50% (IKA 8.75) aan het begin van de studie vs. 80.00% (IKA 8.75) tijdens follow-up, P=0.043). De levenskwaliteit van alle 42 patiënten samen was niet significant veranderd na ECV, maar hun EHRA score vertoonde wel een significante verschuiving naar een Klasse I score (geen symptomen) (P<0.001).

Discussie & conclusies: Deze studie heeft aangetoond dat het informeren van VKF patiënten die ECV als behandeling krijgen hun kennis over VKF alsook hun zelfmanagement verhoogt. Desondanks werd herval van VKF niet sneller vastgesteld in de educatiegroep, aangezien zij niet geïnstrueerd werden om enkele keren per dag hun pols te monitoren. Patiënten die geen educatie krijgen over VKF kunnen deze aandoening niet meer ernstig beschouwen eenmaal de ECV achter de rug is. Dit kan leiden tot therapieontrouw en een verhoogd risico op een beroerte. Meer studies zijn nodig om te achterhalen of educatie in combinatie met een duidelijk polsmeting protocol kunnen leiden tot een snellere detectie van herval in VKF na een succesvolle ECV.

Table of contents

1 Introduction

One in four adults aged over 40 will develop atrial fibrillation (AF) in their lifetime (2). AF is the most common type of cardiac arrhythmia and accounts for one third of all patients hospitalized for cardiac rhythm disorders (3-6). Currently, AF has an estimated prevalence of 1-2% in the general population (7, 8), affecting approximately 6 million people in the European Union (6). This cardiac rhythm disorder is primarily present in the elderly (4, 5), occurring in around 15% of the population aged 65 years and older (9-11). In addition, AF is more prevalent in men than women and in white populations than in non-white peoples (2, 10, 11). Since the risk for developing AF increases with age (9-12), its prevalence and incidence are expected to double in the next 50 years due to longer life expectancy (3-5, 7).

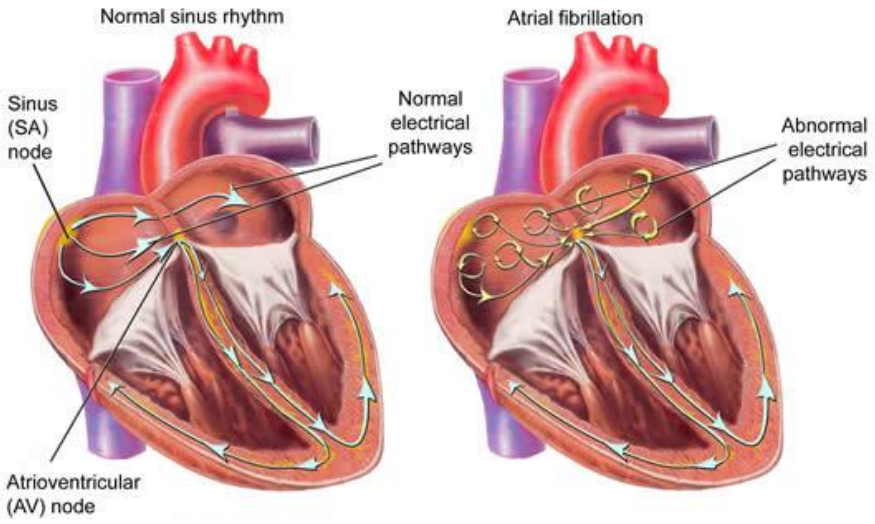

Figure 1: Normal electrical conduction originating from the sinoatrial (SA) node in a healthy heart (left) and a disorganized electrical signaling during atrial fibrillation (right) (1).

In a healthy heart, the electrical signals responsible for contraction initiate in the sinoatrial (SA) node, situated in the right atrium, and travel throughout the heart in a regular pattern (Figure 1, left). Instead, AF occurs when the electrical conduction in the atria is disrupted and chaotic. Besides the normal firing of electrical signals originating from the SA node, extra electrical impulses start at different sites within the atria, often nearby the pulmonary veins in the left atrium (Figure 1, right)(13). These many electrical impulses rapidly fire at the same time, activating the atria in a very fast (300-600 times/min) and irregular manner (14), which leads to fibrillation of the atria instead of proper contraction. Not all of these chaotic atrial electrical signals are conducted through the atrioventricular (AV) node, resulting in an irregular and asynchronous ventricular activation. The ventricular response rate depends on age, medication, AV-nodal conduction properties and ranges from 30 to 200 bpm. In most patients, the ventricular response is often faster than during sinus rhythm, between 90-170 beats per minute (bpm), but is always accompanied by an irregular rhythm (9).

1.1 Risk factors

A variety of predisposing factors are associated with AF, including both cardiovascular and non-cardiovascular risk factors. The most common cardiovascular risk factors are hypertension, congestive heart failure (HF), diabetes mellitus (DM), valvular heart disease (VHD) and coronary artery disease (CAD) (9-11). When AF co-exists with cardiovascular risk factors, the risk of complications associated with AF, such as stroke, is even higher (10). Other non-cardiovascular risk factors include hyperthyroidism, smoking, obesity, intense endurance exercise, alcoholism, drug usage, and obstructive sleep apnea syndrome (OSAS) (9, 10). Since half of the cases of AF can be explained by etiologic risk factors, risk factor modification may prevent the onset of AF (12).

1.2 Complications associated with AF

Although AF itself is not considered a life-threatening disease, it is associated with a high risk for developing acute and/or chronic complications such as stroke and cardiac dysfunction, respectively (5, 7, 9, 10). These complications significantly increase mortality, morbidity, and the number of hospitalizations associated with AF (7, 9, 10). AF is therefore recognized as a significant healthcare burden and negatively impacts patient's quality of life (10).

1.2.1 Stroke

The most important and most common complication of AF by far is thromboembolism (TE), with stroke in particular (10-12). Moreover, AF is responsible for 36% of all strokes in the age category of 80-89 years (11, 12, 15). Stöllberger et. al showed that when stroke is present in patients with AF, they have a worse neurological outcome, an increased in-hospital chance for developing medical complications, and a higher mortality risk than stroke patients without AF (10, 15). Fibrillation of the atria causes loss of organized mechanical contraction. As a result, flow velocity is reduced and blood stasis may occur, mainly in the left atrial appendage (LAA) (11, 12). Hence, most thrombi associated with AF arise within this location (Figure 2) (11).

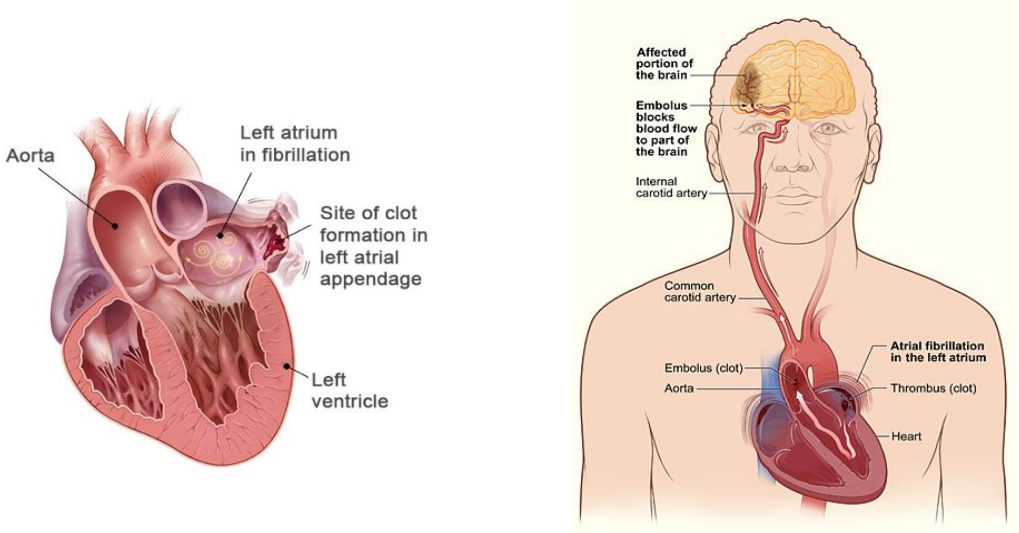

Figure 2: The formation of a thrombus in the left atrial appendage (LAA) in atrial fibrillation. Detachment of the blood clot can lead to stroke (16, 17)

Untreated AF patients have a 5-fold increased risk for developing stroke (2, 5, 6, 10). However, this risk is not homogeneous and depends on the presence of stroke risk factors (10). The risk of stroke in patients with AF can be assessed using the CHA_2DS_2-VASc score (10). The CHA_2DS_2-VASc acronym uses the following risk factors: congestive HF, hypertension, age 75 years or older, DM, previous stroke/transient ischemic attack (TIA)/TE, vascular disease, age between 65 and 74 years, and female sex. Each risk factor counts as one point, except for age ≥ 75 years and the stroke/TIA/TE risk factor, which count as two points (9, 10). Anticoagulation therapy is not recommended in patients with a score of 0, whereas patients with a score of ≥ 1 could be treated with oral anticoagulation (10).

1.2.2 Tachycardia-induced cardiomyopathy

AF patients receiving poor ventricular rate control may develop HF with decreased left ventricular ejection fraction (LVEF), which is also referred to as tachycardia-induced cardiomyopathy (TICM) (11, 18, 19). Apart from the tachycardia as a consequence of poor rate control, AF may also play into the hands of TICM through loss of atrial contractile function, an irregular ventricular response, and AV dyssynchrony (20). The latter is associated with diminished diastolic filling period, reduced cardiac output, elevated ventricular filling pressures, and ultrastructural changes in cardiomyocytes (18-20). TICM is thus characterized by both systolic and diastolic dysfunction (18-20). The hemodynamic and clinical manifestations of TICM are usually reversible upon elimination of the tachyarrhythmia (18-20).

1.3 Types of AF

AF is a progressive disease that can be classified into four categories based on the duration of episodes (Table 1). Patients with *paroxysmal AF* experience intermittent episodes that terminate spontaneously. These episodes generally last <7 days, most terminate within 24 hours. Episodes of *persistent AF* last longer than 7 days and do not self-terminate. Instead, termination of persistent AF requires electrical or pharmacologic cardioversion (see further). Episodes of persistent AF that last longer than 12 months are classified as *longstanding persistent AF*. When the AF episode cannot be reversed back to normal sinus rhythm by means of cardioversion or when this approach is inadvisable, the arrhythmia is classified as *permanent or chronic AF* (9-12).

Table 1: Different types of AF and the duration of their corresponding episodes.

Type of AF	Duration of AF episode
Paroxysmal	<7 days, often termination within 24 hours
Persistent	>7 days, cardioversion is needed
Long standing persistent	>12 months duration
Permanent	> 7 days, cardioversion is unsuccessful or inadvisable

In many cases, AF evolves from paroxysmal to persistent to permanent form. This can be explained by atrial remodelling caused by the arrhythmia, or by progression of underlying cardiac

disease (12). The choice of appropriate therapy and prognosis are defined based on the subtype (9-11, 21).

1.4 Clinical presentation and evaluation

Clinical presentation of AF may relate to the arrhythmia itself or its consequences, such as stroke and HF (9, 11). AF commonly manifests as palpitations, dyspnea, dizziness, fatigue, exercise intolerance, syncope, and chest pain. Furthermore, it may have a significant impact on patients quality of life (3, 9, 11). These symptoms can be explained by several hemodynamic derangements, including loss of organized atrial contraction, irregular heart rhythm, rapid ventricular rate, and bradycardia due to sinus pauses when AF episodes terminate (11). However, one-third of AF patients exhibit no symptoms and many patients with symptomatic AF have also asymptomatic episodes (3, 9, 11, 22). Electrocardiography is used as the first-line method to diagnose AF (9). The electrocardiogram (ECG) of patients with AF shows irregular RR intervals and no distinct P waves (Figure 3)(10). However, since a standard 12-lead ECG is only a snapshot of the electrical activity of the heart (10 s), the arrhythmia cannot always be demonstrated in patients with paroxysmal AF (10). A 24-h Holter monitor or an implantable loop recorder for a period of three years can be used to document AF in those patients who have infrequent AF episodes and/or in patients who have a strong suspicion of AF (9, 10, 23)

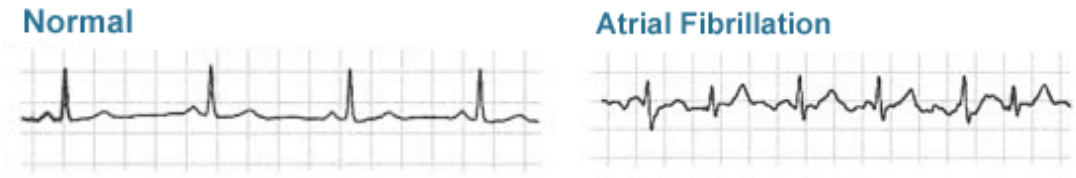

Figure 3: Electrocardiogram of the electrical activity in a normal heart – sinus rhythm - (left panel) and in atrial fibrillation (right panel) (1).

1.5 Management of AF

The primary goals of AF management involve control of symptoms, maintain and/or regain of sinus rhythm, and prevention of complications associated with AF (5, 10, 11). There are three major therapeutic strategies, including anticoagulation therapy to prevent TE and stroke, rate control, and rhythm control (9-11). While the latter two are considered different AF treatment modalities, they are often combined in practice. Besides these three major therapeutic approaches, should the management of AF also focus on early identification and treatment of etiologic factors and comorbidities (10). In addition, although the importance of extrinsic risk factors (e.g. smoking, alcoholism, obesity) may be overlooked, lifestyle modification is considered an important strategy in the management of AF (12).

1.5.1 Rate control

In AF patients who experience a rapid ventricular rate, a rate control strategy is required. Overall, it is important to achieve rate control for each patient during daily activities and to prevent rapid heart rates and dyspnea (3, 11). A resting ventricular rate <110 bpm is recommended in order to

prevent TICM (24). Ventricular rates exceeding these parameters are considered tachycardic (19). In most AF patients, β-Adrenergic blockers or calcium channel antagonists are the first-line drugs for ventricular rate control (9, 10). Rate control will improve diastolic filling and coronary perfusion and will decrease myocardial energy demand. This will in turn preserve myocardial function and prevent development of TICM (3, 9). In AF patients with the tachycardia-bradycardia syndrome, i.e. rapid ventricular rates during exercise and sinus bradycardia (sinus pauses when the AF episode terminates) or slow ventricular rates during AF in rest, control of ventricular rate can be challenging and permanent pacemaker implantation might be indicated (11).

1.5.2 Rhythm control

Rhythm control focuses on achieving normal sinus rhythm, which can be accomplished either by cardioversion, cardiac catheter ablation, or a combination of both (3).

✓ ***Cardioversion***

Most patients (up to 50%) with recent onset AF convert back to sinus rhythm spontaneously (10). However, for patients in whom this is not the case or in patients who remain symptomatic despite ventricular rate control, normal sinus rhythm can be restored using either pharmacological or electrical cardioversion (10, 11). Cardioversion, reconverting the arrhythmia back to sinus rhythm, is commonly performed in patients with paroxysmal or persistent AF (10, 11, 25).

- *Direct-current or electrical cardioversion*

The goal of electrical or direct-current cardioversion (DCC) is to terminate the AF episode by providing an electrical shock to the heart muscle by means of a defibrillator (26, 27). Its efficacy and safety in converting AF and other arrhythmias back to sinus rhythm were first demonstrated by Lown et al. (28). By means of direct current instead of alternating current, the electrical shock of 2.5 ms duration (>800 volt, 100-200 Joule mono- or biphasic shock) can be applied synchronously with the cardiac cycle and at the precise moment, which is right after the R wave of the ECG (26, 27). Hence, there is no risk for ventricular fibrillation (26, 27). Prior to DCC, the patients require anaesthetics, since the shocks are painful (11).

- *Pharmacological cardioversion – antiarrhythmic drugs*

Antiarrhythmic drugs can be used under two conditions: firstly, in an attempt to reconvert AF back to normal sinus rhythm (i.e. pharmacological cardioversion), and secondly, in order to maintain sinus rhythm and to reduce the chances of AF recurrence after successful cardioversion (4, 11). The success of pharmacological cardioversion (PC) using antiarrhythmic agents is largely determined by the duration of AF (11). AF duration of less than 7 days can be converted back to sinus rhythm in 34-95% of patients within 24h, while for AF of more than 7 days duration, PC is only effective in 15-40% of patients (10, 29). Hence, electrical cardioversion would be more effective in these patients (10, 29). The choice of antiarrhythmic drug is determined based on the potential side effects related to the drug (11). The most common antiarrhythmic drugs used for PC are amiodarone and flecainide, with each having their own advantages and disadvantages (14). Other antiarrhythmic drugs used for long-term maintenance of sinus rhythm include sotalol,

flecainide, and propefanon. These are the first-line agents in lone AF or in patients with no or minimal heart disease (10, 11, 14).

A disadvantage of PC is the fact that maintenance of normal sinus rhythm is difficult to achieve using antiarrhythmic agents due to therapy adherence, tolerance, the limited long-term effectiveness and the risk of long-term toxic effects related to the drug (9). However, PC does not require conscious sedation or anaesthesia compared to DCC (10). In general, DCC is the technique of choice, because it is often faster and more effective than PC (10, 30). In addition, if the patient is hemodynamic unstable (e.g. due to hypotension, severe HF) emergency electrical cardioversion is necessary (9).

✓ ***Catheter Ablation***

Another approach for achieving sinus rhythm apart from cardioversion is cardiac catheter ablation (14, 20). Recent data showed that catheter ablation should also be considered as first-line therapy in highly symptomatic patients and in patients with impaired LV function (31). In addition, this technique is associated with a lower long-term risk of adverse events in contrast with antiarrhythmic agents (32). Since most triggers of AF are found within the musculature of the pulmonary veins and propagate into the atrial body, pulmonary vein antrum isolation is considered a standard catheter ablation approach to isolate this musculature and the electrical impulses originating from it (14, 20). However, sometimes a second ablation is needed in up to 20% of the patients due to the recovery of pulmonary vein connections (14, 20). The Cleveland Clinic has reported a 1-year efficacy rate between 75-80% for patients with paroxysmal AF following a single procedure and 85-90% rate following a second ablation (14). The efficacy rates for patients with persistent AF and long-standing persistent AF are lower (14, 20). When patients still continue to experience symptoms from a rapid or irregular ventricular rhythm despite drug therapy, catheter ablation of the AV-conduction system and permanent pacemaker implantation are highly recommended for establishing permanent rate control during AF (11, 19). This AV nodal ablation procedure is mainly for older patients with significant co-morbidities (20). Furthermore, the PAVE study showed that the combination of AV nodal ablation and pacemaker implantation provides beneficial cardiac resynchronization in patients with impaired systolic function or in symptomatic HF patients (33).

1.5.3 Anticoagulation therapy for prevention of stroke

Anticoagulation therapy is a standard procedure and is always combined with rate or rhythm control in patients at high risk for stroke (9, 11).

✓ ***Anticoagulation therapy and cardioversion***

Anticoagulation therapy should be provided for several (3-4) weeks before cardioversion to avoid the occurrence of thromboembolic events (7, 9). In urgent circumstances, transoesophagal echocardiography (TEE) and intravenous anticoagulation are performed immediately before cardioversion (11). After conversion from AF to sinus rhythm, atrial function does not return to normal immediately and the left atrial mechanical function may be impaired for up to several

weeks. In general, anticoagulation therapy is required both before and after cardioversion, regardless of the strategy (9).

✓ ***Stroke risk vs. bleeding risk***

There are no differences in indication for anticoagulation therapy between the different types of AF (11). However, decisions about the use of anticoagulation therapy in older patients can be challenging, since both the risk of stroke as well as the risk of experiencing adverse effects from anticoagulation therapy (e.g. bleeding events) is higher in those patients (9). The risk of bleeding in patients taking anticoagulation can be predicted using the HAS-BLED (uncontrolled Hypertension, Abnormal renal/liver function, Stroke, Bleeding history or predisposition, Labile International Normalized Ratio (INR), Elderly >65 years, Drugs/alcohol concomitantly) score (10). Balancing of stroke prevention (CHA_2DS_2-VASc score) and bleeding risk is important for optimizing outcomes and should always be performed for each patient individually (9-11). Good anticoagulation control is associated with a low risk of stroke and bleeding (10).

1.6 AF management: facing problems

Despite improvements in medicine over the last decades, there are still some gaps in the management of AF. The first one is therapy-related, comprising the high number of patients relapsing into AF after successful DCC. The second gap is patient-tailored and involves insufficient self-management activities due to the lack of important AF knowledge.

1.6.1 AF recurrence after DCC

Although the initial success rate of DCC in patients with persistent AF ranges from 70 to 95%, recurrence of AF is very high (6, 11, 25, 30, 34-37). Several studies have revealed that more than half of the patients relapse into AF after successful DCC, especially during the first weeks (25, 34, 35, 37, 38). The research group of Edoute showed that less than 40% of cardioverted patients remain in sinus rhythm after one year of follow-up (25, 35, 38). In addition, by this time almost half of the patients progressed into permanent AF (34). It is therefore important to recognize that DCC should not be considered a long-term solution for patients with AF, but it is only a temporary improvement of patient's symptoms and quality of life.

Several factors have been identified to predict immediate success rate and the risk of AF recurrence after cardioversion (25, 30, 35). The factor which has mostly been associated with unsuccessful cardioversion and relapse into the arrhythmia is prolonged duration of AF (30, 34, 35, 38). The longer AF persists, the more difficult to restore normal sinus rhythm and the more easily AF recurrence occurs after DCC (34, 35, 38). This is related to atrial remodelling caused by longer duration of AF episodes (35, 36). The aforementioned involves electrophysiological, morphological and structural changes of the atria, making them more vulnerable for relapses into AF (35, 36, 38-40). Other factors predicting unsuccessful cardioversion and recurrence of AF after cardioversion are smoking, the presence of OSAS (4), and the patient's weight (30, 35), in which obesity has been associated with an adverse outcome of cardioversion (30, 34, 35).

Due to the high recurrence rate of AF post-DCC, patients are often relapsed into the arrhythmia by the time their next follow-up appointment with their cardiologist takes place. However, most patients, particularly asymptomatic patients, are not aware of their relapse as a result of insufficient self-management activities (e.g. daily pulse monitoring). In addition, only a small number of patients that do notice their relapse into AF find this important enough to consult a healthcare provider *before* the time of their follow-up appointment. Hence, the majority of patients in which AF recurrence post-DCC occurred, are not seeing a physician only until a few weeks or months after the return of the cardiac rhythm disorder. However, during this time period of AF recurrence, there is a high risk of developing complications related to the arrhythmia, such as stroke and TICM (11). It is therefore also important that AF patients continue to take their anticoagulation medication properly, even after successful cardioversion (9, 11).

1.6.2 Lack of patient knowledge of AF

Several studies have shown that the knowledge of many AF patients about their condition is poor and insufficient (2, 3, 7, 8, 41). The AF Aware group revealed that 25% of patients are unable to explain AF (42). In addition, the majority of AF patients are not aware of their symptoms and do not understand the cause of their disease (3, 5, 7). They also lack knowledge about possible complications related to untreated AF, and the risks and benefits associated with their treatment, despite being treated for AF for several years (3). The latter is particularly the case for patient's knowledge related to anticoagulation therapy, increasing the risk of bleeding and/or TE (7, 8, 41). These gaps in AF patient's knowledge may be attributed to the lack of appropriate educational information and explanations given by physicians, due to the time constraints ('Time is money') and high workload (41). Nevertheless, it has been indicated that patients wish for more information about their treatment options (3).

These AF knowledge deficits may also influence the perceptions AF patients form about their disease and treatment (2). The AF Aware group investigated the perception and attitudes in 825 AF patients and showed that only 55% considered AF as a serious disease (42, 43). Hence, this may also impact on their practical ability to manage treatment, thereby reducing their contribution in self-management roles (2). Recommended self-management behaviors include patient monitoring for signs and symptoms of AF (i.e. daily pulse checking), adhering to a prescribed medication and/or lifestyle regimen, and attending to follow-up appointments (5). Insufficient self-management activities may therefore trigger relapse of AF post-DCC by lack of medication compliance and/or may delay its detection by not performing daily pulse self-examination. Hence, inadequate or improper implementation of self-management activities puts the patient at risk for complications associated with AF, such as stroke, bleeding, and uncontrolled heart rates which may contribute to TICM (5, 43). Non-adherence to a therapeutic regimen is therefore associated with recurrences of AF episodes and rehospitalization (5, 43).

To increase patient's knowledge of their disease, an organized and efficient clinical pathway should be developed and implemented. A strategy may involve the implementation of an AF clinic. Such a clinic should comprise an effective disease management program, in which there is a devoted

multidisciplinary team. This program integrates diagnostic and therapeutic procedures. However, an integrated management approach also consists of communication and education. Since a consultation time is limited and expensive, there is a lack of time for the physician to educate the patients. A consultation is thus less focused on non-medical aspects. Hence, a clinical nurse specialist (CNS) can assess patient's educational needs and provide personalized patient education. This integrated care plan may lead to improvements in quality of life and patient's self-management activities (22).

Taken together, there is thus a need for a change in AF management to improve the contribution of AF patients in their self-management roles and to decrease the number of AF recurrence and rehospitalizations after successful DCC.

1.7 Aim of the study

Numerous studies have reported the importance of patient education and the understanding of patient's perceptions, attitudes and behaviour towards their disease and treatment regimen. Patient education is necessary to improve AF patient's knowledge regarding their disease and treatment (2, 41-43). This will in turn influence behavioural changes towards lifestyle and treatment, which is essential to optimise the management of AF (2, 7, 43).

AF patients should be informed about the importance of adhering to prescribed medical regimes and lifestyles, among other things (41). Hence, medication compliance will be enhanced if patients know the reasons for taking their medication, what will happen if they fail to adhere, and possible side effects related to the drugs (7, 41). Educational interventions should also comprise information regarding the nature of AF and the consequences of untreated AF. This will lead to an increase in awareness of AF, symptom monitoring (e.g. daily pulse monitoring), and clinic attendance, thereby improving patient participation in the management of their own treatment (2, 7, 41, 43). Patient education is thus essential for increasing the knowledge of AF patients about their disease and treatment, leading to effective self-management activities and a reduction in the prevalence of non-adherers (2). This has in turn been associated with an improved quality of care, better healthcare outcomes, and less adverse events such as stroke and bleedings (2, 5, 43).

By providing appropriate education to AF patients who will undergo DCC as a treatment approach, we hypothesize that the knowledge of these patients about their disease and treatment will be enhanced, leading to improved self-management activities and a faster detection of AF recurrence after successful DCC. Eventually, AF management will be improved, leading to a decrease in complications and the number of rehospitalizations related to AF.

The objectives of the study are:

- To investigate whether patient education will lead to an improved knowledge of AF patients about their condition and treatment; such as the cause of AF, symptoms, complications associated with untreated AF, goal of DCC, importance of medication compliance, etc.
- To investigate whether patient education will lead to an enhanced contribution of patients in their self-management roles and change patient's perception and attitude towards AF in a positive way.
- To investigate whether an enhanced contribution of patients in their self-management roles may lead to a faster detection in case of relapse into AF after successful DCC.
- To investigate whether DCC improves patient's quality of life and reduces their symptoms.
- To evaluate the prescription of AF medication before and after DCC.

2 Subjects and methods

A prospective randomized clinical trial was conducted between January and June 2015 at the Department of Clinical Cardiology, Arrhythmology and Electrophysiology of the hospital "Ziekenhuis Oost-Limburg" (ZOL, Genk).

2.1 Study population

All patients aged between 18 and 80 years with paroxysmal or persistent AF who were referred for electrical cardioversion were eligible for the study. AF was diagnosed and documented by ECG, either 12-lead or Holter monitoring. In addition, AF was categorized according to the American College of Cardiology, American Heart Association, and European Society of Cardiology (ACC/AHA/ESC 2014) guidelines. Patients were excluded if they were non-Dutch speakers, had a disease at the terminal stage, mental limitations in completing the questionnaires, or when atrial flutter or other arrhythmia were documented. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Local Ethics Committee. All participants provided written informed consent.

Socio-demographical and clinical characteristics were retrieved from patient's medical records using MEDAR database, a software program providing patient information regarding cardiology (AGFA healthcare, Mortsel, Belgium). In addition, patient's highest educational level completed, occupational status, alcohol and caffeine usage, smoking status, and drug history were collected during a short interview. Patients seriousness of symptoms and limitations on physical activity related to AF were determined based on the European Heart Rhythm Association (EHRA) score of AF-related symptoms (21). The patient's individual risk for stroke and bleeding were assessed using the CHA_2DS_2-VASc score and HAS-BLED score, respectively. After screening, patients were randomly assigned to receive education (intervention group) or usual care (control group) on a 1:1 basis.

2.2 Educational intervention

The educational intervention was performed in addition to usual care and consisted of verbal patient education accompanied by information booklets. Prior to the intervention, patient's baseline knowledge levels regarding their condition and treatment were determined by means of questionnaires (see further). Based on these results or patient's additional questions, the patient education focused on topics of which knowledge was lacking or inadequate. In general, patients were informed about the pathophysiology of AF, symptoms, risk factors, complications, and the different treatment modalities associated with the arrhythmia. Since all participants would undergo electrical cardioversion, more detailed information was provided about the course, goal, success rate, and the risks and benefits associated with DCC. Furthermore, patients were also instructed about the importance of medication compliance, lifestyle changes according to their AF condition (e.g. smoking cessation, weight loss, physical exercise, restricting alcohol), and pulse monitoring as indicated in the AF booklet ('how to measure your pulse'). Furthermore, patients were given advise on consulting a healthcare provider in case of an irregular pulse measurement after

successful DCC. In this way, every effort was made to engage the patient's active participation in self-management activities. The impact of the intervention on outcomes was assessed at follow-up, of which the schedule was determined by the cardiologist. Patients who did not have a follow-up consultation planned at the hospital were contacted by telephone to complete the follow-up questionnaire.

2.2.1 Information booklets

The patient education was provided in understandable layman terms during a face-to-face interview by means of two information booklets, which were particularly made for the study; one about AF in general and one regarding DCC. The researcher went through the educational booklets with the patient and were given afterwards to take home. During the educational intervention, patients were also able to ask any questions. The AF information booklet was an updated version of an already existing ZOL brochure about AF, which was no longer used and inaccurate. The booklet about DCC on the other hand was newly made and based on the knowledge of cardiologists and the use of DCC in clinical practice. The content of both booklets was checked by different cardiologists and the head nurse of the Coronary Care (CCU) and Chest Pain Unit (CPU).

2.3 Routine clinical care

All AF patients assigned to the control group received usual care without the support of educational interventions. They did not obtain the AF and DCC booklets, nor were provided with face-to-face patient education. Instead, all diagnostic and therapeutic procedures were discussed by the general practitioner or cardiologist during consulting hours. In case of an emergency admission, information about the arrhythmia and electrical cardioversion was provided the moment before the electrical shock and was given by the cardiology specialists.

2.4 Questionnaires

All patients were asked to fill in questionnaires at baseline and follow-up to evaluate their knowledge of AF and DCC, self-management activities (e.g. medication and lifestyle compliance, symptom monitoring), attitude and perception regarding AF, and quality of life. If the patient did not wanted to fill these questionnaires by their own, the investigator would interview the patient and complete the questionnaire. When data was lacking, patients were called for supplement.

2.4.1 Knowledge of AF

The knowledge AF patients have about their disease was assessed using a questionnaire that was designed based on the AF Knowledge Scale, which was recently developed by Hendriks et. al (43). Question number 11 of the AF Knowledge Scale ("What is the function of the thrombosis center?") was left out of the study questionnaire due to its irrelevance, since there are no thrombosis centers in Belgium. The remaining questions and answers (3 options for each question) were translated into Dutch (See Appendix p. 53-54). Eventually, the AF knowledge questionnaire used for the study consisted of 10 multiple choice questions and covered items such as AF in general, symptom recognition and treatment (e.g. importance of anticoagulation therapy). Each question comprised

three possible answers, with one being the correct one. A correct answer yielded 1 point, while incorrect or unknown answers were scored 0. Four additional open-ended questions, derived from the knowledge survey of patients with AF undergoing radiofrequency catheter ablation (7), were added to this questionnaire to investigate whether patients have knowledge of the consequences of untreated AF (stroke, HF) , the different treatment modalities of AF (medication, DCC, ablation, pacemaker), the side-effects of anticoagulation therapy (i.e. complications related to a higher (bleedings) or lower (formation of thrombi) dose intake than prescribed), and the impact of smoking on AF (nicotine increases the heart rate, which may trigger AF). The latter was invalid for non-smoking patients. In order to receive a score of 1 on each open-ended question, patients needed to report all the correct answers to that question. An exception was made for the open-ended question related to the different treatment modalities of AF, for which at least two correct answers were needed in order to score 1 point. The total score of AF knowledge was obtained by summing up the number of correct answers for each question, with higher scores indicating a better knowledge of AF.

2.4.2 Knowledge of DCC

There was no existing questionnaire that assessed the knowledge of DCC of AF patients undergoing the procedure. Hence, a structured DCC knowledge questionnaire was designed based on the content of the DCC information booklet (See Appendix p. 54). The questionnaire consisted of 10 propositions. Patients had to mark whether they thought the proposition was true or false. A correct answer was scored 1 point, an incorrect or blank answer received a score 0. The total score was obtained by summing up the number of correct answers, with higher scores indicating a better knowledge about electrical cardioversion.

2.4.3 Attitude and behavior regarding AF

The questionnaire that was used to determine the attitude AF patients have and the perceptions they form about their disease consisted of 8 items which were selected out of the attitude scale developed by Xu et. al (7). These 8 items comprised severity of AF, periodic follow-up, daily pulse self-examination, etc. (See Appendix p. 55). For each item, patients had to rate their self-care attitude on a five-point Likert scale ranging from "I completely agree" to "I do not agree at all". For invert questions, the answer of "I completely agree" was scored 1 and "I do not agree at all" was scored 5 points. The opposite was true for non-invert questions. The total score was calculated by summing up the scores of each item. A higher score indicated a more positive attitude towards their condition.

2.4.4 Self-management

The self-management questionnaire (see Appendix p. 56) comprised questions to determine patient's knowledge about a healthy lifestyle (e.g. weight reduction, exercise, alcohol restriction) and self-monitoring (e.g. daily pulse self-examination) (Behavior survey, (7)). Question number 7 ("Do you quit or restrict smoking according to your AF condition?") was invalid for non-smokers. In addition, the Morisky's self-reporting, medication taking-adherence scale (MMAS, 8-item) was used to assess AF patient's medication compliance (44). The questionnaire was translated into Dutch

and used to evaluate whether patients forget to take their medication, stop to take their prescribed medication, etc. Three questions of the MMAS were left out of the study questionnaire due to an overload of total questions. Patients had to respond "Yes", "No", or "Unknown" to each question. A correct answer was scored 1, an incorrect or unknown answer was scored 0. Scores of each question were summed up, with higher scores indicating a better self-management behavior.

2.4.1 Quality of life

Patient's quality of life was measured by means of the Dutch Medical Outcomes Study 36-Item Short Form Survey Instrument (SF-36)(45). The SF-36 is a standardized questionnaire consisting of 36 questions, with each question having different response choices. It is used to evaluate eight sections, including physical functioning (PF), social functioning (SF), role limitations due to physical health problems (RP), role limitations due to emotional problems (RE), mental health (MH), vitality (VT), bodily pain (BP), general health perceptions (GH), and change in health (CH). For each section, the weighted sum of the questions covering the representing section is calculated and transformed into a 0-100 scale. The higher the score, the higher the level of functioning or well-being.

2.4.2 Evaluation educational intervention

After the 21 AF patients who were randomly assigned to the education group received patient education, they were asked to fill in an evaluation form regarding the verbal information that was provided and the AF and DCC booklets that they were given to take home (See Appendix p. 57). They were asked to rate each item of the educational intervention on a five-point Likert scale consisting of "excellent" (score of 5); "very good" (score of 4); "good" (score of 3); "moderate" (score of 2); or "bad" (score of 1). At follow-up, patients were also asked if they had read the booklets they were given to take home.

2.4.3 Follow-up questionnaire

At follow-up, all patients were asked if they had experienced any symptoms of AF post-DCC, if they had consulted their general practitioner or the emergency services regarding these symptoms, if they had searched for more information about AF-related topics, and if they had forgotten to take their medication once and/or several times in the period post-DCC and their follow-up appointment.

2.5 Electrical cardioversion procedure

Electrical cardioversion was performed according to clinical practice during a short hospital stay at the CPU CCU unit. Cardiac rhythm was continuously monitored from the time of admission up until discharge, which was 1h post-DCC. Prior to cardioversion, a TEE was performed to exclude left atrial thrombi. An exception was made for patients who were treated with chronic anticoagulant drugs. In fasting patients, light general anesthesia was induced by intravenous propofol. The dose of the anesthetic depended on patients age and weight. In addition, all patients received oxygen supplementation before and after the electrical shock. Adhesive electrodes and paddles were placed in the right second intercostal space and in left-sided lateral position along the midaxillary

line. A biphasic R wave synchronized shock was applied by the cardiologist. If the first shock failed to restore sinus rhythm, two more attempts were made with a maximum number of three shocks. If the second shock failed, the electrodes and paddles were relocated to an antero-posterior position (one electrode on the sternum, one interscapular on the back of the patient). Successful DCC was defined as a stable sinus rhythm for more than 1h following the cardioversion procedure. After the cardiologist performed a clinical check, the patient was dismissed from the hospital. Recurrence of AF after dismissal were considered relapses. Clinical follow-up was scheduled for all patients several weeks after DCC in the clinic. Maintenance of sinus rhythm was evaluated by ECG.

2.6 Data analysis

Continuous variables (age, body mass index (BMI), duration of AF) are presented as mean and standard deviation (SD) or median and interquartile range (IQR) when the normality test failed. Normality of the data was assessed by the Shapiro-Wilk statistic. Discrete variables such as gender, medication, risk factors, education level, co-morbidities, etc. are presented as absolute number and percentage (%). Independent two-sided t-test or a Mann-Whitney test were performed to compare continuous variables between two groups, while categorical data were compared using Chi-square and Fisher's exact test (when expected count <5 or observed count <10). The paired t-test or Wilcoxon signed-rank test were used to compare variables at baseline and follow-up. Association between two categorical variables was assessed using the Chi-square test for independence. Pearson correlation was used to assess possible correlations between two normally distributed continuous variables. The Spearman's rank-order correlation was used as the nonparametric version of the Pearson correlation. All analyses were two-sided and a p-value <0.05 was considered statistically significant. When all statistical data was evaluated, a power analysis was performed. Data were analyzed with the Statistical Package for Social Sciences Version 22.0 (SPSS Inc, Chicago, Illinois, USA).

3 Results

In total, 48 patients provided written informed consent and were randomly assigned to either the intervention group (i.e. receiving patient education) (n=24) or the control group (i.e. receiving usual care) (n=24). Two patients did not complete the baseline questionnaires due to mental limitations and were excluded from the study. In addition, not all questionnaire data was concluded from one patient due to time restraints. At follow-up, one patient was excluded because of worsening of general health condition (n=1), while another patient terminated voluntary study participation (n=1). In between the baseline and follow-up period, one patient had died. Data analysis was only performed for patients who completed the questionnaires both at baseline and at follow-up. Of the patients, 21 in the education group as well as 21 in the usual care group were included in the final analysis (Figure 4).

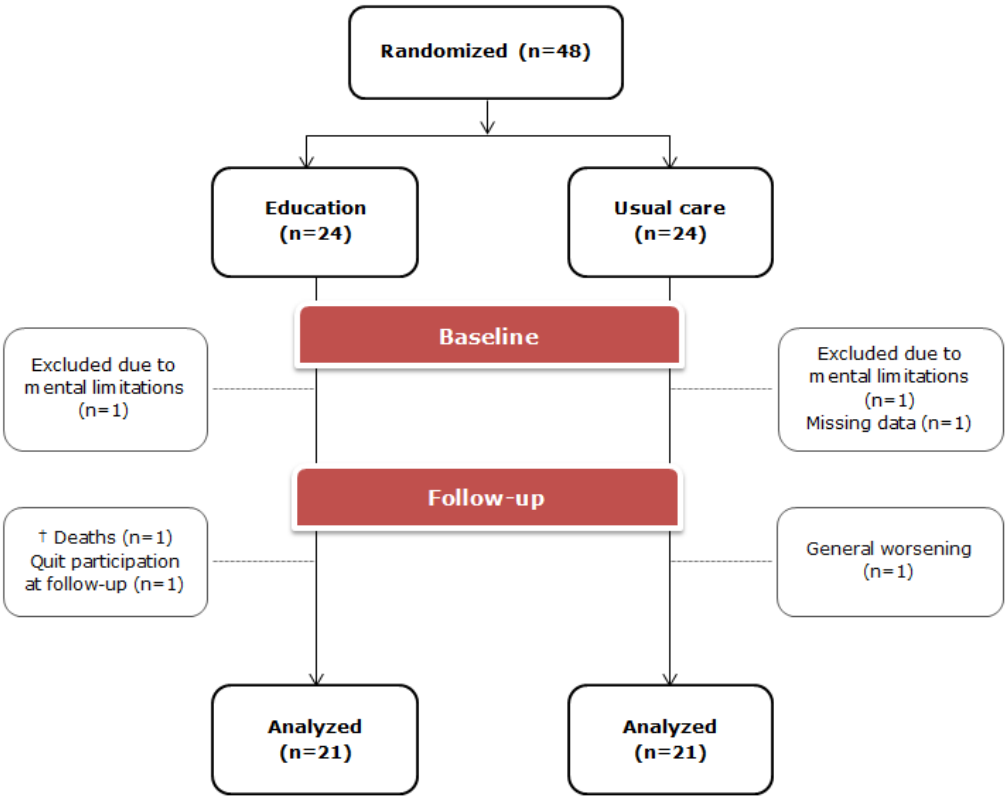

Figure 4: Overview of the total study population at baseline and follow-up.

3.1 Characteristics of the patients

The entire study population consisted of 42 AF patients, randomly divided among the education group (n=21) and the usual care group (n=21). Overall, the groups were well matched. Patient's baseline characteristics are summarized in Table 2. The total patient population had a mean age of 65.31 ± 8.75 years with 81% being male. In addition, 52.4% were overweight, having a BMI between 25-29.9, and 14.3% were obese (BMI>30). The vast majority completed secondary

education. Patients with paroxysmal AF were overrepresented (71.4%) compared to persistent AF (28.6%). The duration of AF was defined as the time between ECG-verified diagnosis of AF and electrical cardioversion, due to difficulty in establishing the actual duration of the arrhythmia. Furthermore, the larger part had never undergone any previous DCC attempts before (57.1%). Mean follow-up duration was 4.62 ± 1.65 weeks and did not differ between the two groups. The alcohol usage was significant different between the education and the usual care group (P=0.035), with 57.1% of patients in the usual care group reported to drink ≤3 glasses per week, compared to 23.8% in the education group (P=0.028). No statistically significant differences were observed with respect to socio-demographic characteristics, non-cardiovascular risk factors, clinical parameters, co-morbidities, and risk predictor scores (CHA_2DS_2-VASc and HAS-BLED) at baseline (Table 2).

Table 2: Baseline characteristics of AF patients in the education group (n=21), usual care group (n=21) and the total study population (n=42).

Variable	Education (n=21)	Usual care (n=21)	Total study population (n=42)	P-value†
Socio-Demographics				
Age, years	65 ± 10.65	65.62 ± 6.58	65.31 ± 8.75	0.822
Male gender – n (%)	17 (81.0)	17 (81.0)	34 (81.0)	1
Follow-up, weeks	4.28 ± 1.82	4.95 ± 1.43	4.62 ± 1.65	0.195
BMI – n (%)				0.265
<18.5	1 (4.8)	0 (0.0)	1 (2.4)	
18.5-24.9	6 (23.8)	8 (38.1)	13 (31)	
25-29.9	11 (52.4)	11 (52.4)	22 (52.4)	
>30	4 (19.0)	2 (9.5)	6 (14.3)	
Highest educational level completed – n (%)				0.262
Primary education	2 (9.5)	4 (19.0)	6 (14.3)	
Secondary education	11 (52.4)	14 (66.7)	25 (59.5)	
Higher education or university education	8 (38.1)	3 (14.3)	11 (26.2)	
Occupation – n (%)				0.410
Employed	5 (23.8)	2 (9.5)	7 (16.7)	
Unemployed	0 (0.0)	1 (4.8)	1 (2.4)	
Retired	16 (76.2)	18 (85.7)	34 (81.0)	
Marital status – n (%)				0.107
Single	2 (9.5)	0 (0.0)	2 (4.8)	
Married/co-habiting	17 (81.0)	21 (100)	38 (90.5)	
Divorced	2 (9.5)	0 (0.0)	2 (4.8)	
Non-cardiovascular risk factors – n (%)				
Smoking				0.263
Yes	4 (19.0)	1 (4.8)	5 (11.9)	
Never	6 (28.6)	10 (47.6)	16 (38.1)	
Quit	11 (52.4)	10 (47.6)	21 (50.0)	
Alcohol usage (drinks/week)				**0.035***
0	6 (28.6)	2 (9.5)	8 (19)	0.238
≤3	5 (23.8)	12 (57.1)	17 (40.5)	**0.028***
3-8	4 (19)	6 (28.6)	10 (23.8)	0.469

≥8	6 (28.6)	1 (4.8)	7 (16.7)	0.093
Caffeine usage (drinks/day)				0.348
0	2 (9.5)	3 (14.3)	5 (11.9)	
≤2	8 (38.1)	3 (14.3)	11 (26.2)	
2-6	10 (47.6)	12 (57.1)	22 (52.4)	
≥6	1 (4.8)	3 (14.3)	4 (9.5)	
Clinical characteristics – n (%)				
History of AF				0.350
Yes	10 (47.6)	14 (66.7)	24 (57.1)	
Newly diagnosed	11 (52.4)	7 (33.3)	18 (42.9)	
Type of AF				0.306
Paroxysmal	13 (61.9)	17 (81.0)	30 (71.4)	
Persistent	8 (38.1)	4 (19.0)	12 (28.6)	
Duration of AF (days)				0.146
≤7	13 (61.9)	17 (81.0)	30 (71.4)	
8-13	4 (19.0)	0 (0.0)	4 (9.5)	
≥14	4 (19.0)	4 (19.0)	8 (19.0)	
Previous DCC attempts				0.212
0	14 (66.7)	10 (47.6)	24 (57.1)	
≥1	7 (33.0)	11 (52.4)	18 (42.9)	
Previous catheter ablation				0.095
0	17 (81.0)	12 (57.1)	29 (69.0)	
≥1	4 (19.0)	9 (42.9)	13 (31.0)	
Hospital admission				0.751
Emergency case	7 (33.3)	9 (42.9)	16 (38.1)	
Consultation	14 (66.7)	12 (57.1)	26 (61.9)	
EHRA score				0.162
Class I	10 (47.6)	5 (23.8)	15 (35.7)	
Class II	7 (33.3)	5 (23.8)	12 (28.6)	
Class III	2 (9.5)	7 (33.3)	9 (21.4)	
Class IV	2 (9.5)	4 (19.0)	6 (14.3)	
Co-morbidities – n (%)				
Pacemaker	2 (9.5)	4 (19.0)	6 (14.3)	0.663
Stent	3 (14.3)	3 (14.3)	6 (14.3)	1
Hypertension	12 (57.1)	11 (52.4)	23 (54.8)	1
Previous MI	2 (9.5)	1 (4.8)	3 (7.1)	1
CAD	4 (19.0)	4 (19.0)	9 (21.4)	1
Ischemic HF	7 (33.3)	8 (38.1)	16 (38.1)	1
VHD	6 (28.6)	7 (33.3)	14 (33.3)	1
Previous TIA/stroke/TE	0 (0.0)	0 (0.0)	1 (2.4)	
Thyroid disease	1 (4.8)	0 (0.0)	1 (2.4)	1
DM	3 (14.3)	1 (4.8)	5 (11.9)	0.606
COPD	1 (4.8)	3 (14.3)	4 (9.5)	0.606
OSAS	3 (14.3)	1 (4.8)	5 (11.9)	0.606
Hypercholesterolemia	8 (38.1)	5 (23.8)	13 (31.0)	0.505
Lone AF	3 (14.3)	2 (9.5)	5 (11.9)	1

Risk predictors – n (%)				
CHA_2DS_2-VASc score				0.094
0	1 (4.8)	3 (14.3)	4 (9.5)	
1	6 (28.6)	2 (9.5)	8 (19.0)	
2	3 (14.3)	10 (47.6)	13 (31.0)	
3	6 (28.6)	3 (14.3)	9 (21.4)	
4	4 (19.0)	3 (14.3)	7 (16.7)	
5	1 (4.8)	0 (0.0)	1 (2.4)	
HAS-BLED score				0.240
0	0 (0.0)	0 (0.0)	0 (0.0)	
1	1 (4.8)	6 (28.6)	7 (16.7)	
2	8 (38.1)	5 (23.8)	13 (31.0)	
3	8 (38.1)	7 (33.3)	15 (35.7)	
4	3 (14.3)	1 (4.8)	4 (9.5)	
5	1 (4.8)	2 (9.5)	3 (7.1)	

Data are presented as mean ± standard deviation (SD) for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. Categorical variables are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation; *BMI* body mass index; *DCC* direct-current cardioversion; *EHRA score* European Heart Rhythm Association score of AF-related symptoms; *MI* myocardial infarction; *CAD* coronary artery disease; *HF* heart failure; *VHD* valvular heart disease; *TIA* transient ischemic attack; *TE* thromboembolism; *DM* diabetes mellitus; *COPD* chronic obstructive pulmonary disease; *OSAS* obstructive sleep apnea syndrome; *CHA_2DS_2-VASc score* congestive heart failure, hypertension, age ≥ 75, diabetes mellitus, previous stroke/TIA/TE, vascular disease, age between 65 and 74 years, female sex score. Each risk factor counts as one point, except for age ≥ 75 years and the stroke/TIA/TE risk factor, which count as two points; *HAS-BLED score* uncontrolled Hypertension, Abnormal renal/liver function, Stroke, Bleeding history or predisposition, Labile International Normalized Ratio (INR), Elderly >65 years, Drugs/alcohol concomitantly score † comparison between education and usual care

3.2 Electrical cardioversion

A flowchart of the immediate and long-term success rate of DCC within the study population is demonstrated in Figure 12 (See Appendix). Of the total 42 patients, two converted to normal sinus rhythm spontaneously and, hence, did not undergo electrical cardioversion. However, both of them relapsed into AF as documented on ECG at follow-up. DCC was successful in 90% of the patients; 58.3% of them persisted normal sinus rhythm at follow-up, while AF or atrial flutter was present in 27.8%. Whether recurrence of AF had occurred at follow-up was unknown for five patients (13.9%), because these patients had no follow-up consultation planned at the department of Cardiology in ZOL, but were seen at other departments or outside the hospital. Consequently, no ECG was made at follow-up. Of the patients in which DCC was not successful, cardioversion into sinus rhythm had occurred in two of them (either pharmacological or by a new DCC attempt), while the other two patients were still in AF at follow-up.

3.2.1 Correlations

Different variables were tested for a possible correlation with a successful DCC. BMI, age, duration of AF, type of AF, history of AF, previous DCC attempts, previous ablation procedures, EHRA score, the use of anti-arrhythmic drugs, alcohol usage, caffeine usage, smoking status, and the presence of co-morbidities all showed no statistically significant correlation. Only a statistically significant association was found between gender and the success rate of DCC ($P=0.039$, $R^2=0.327$), with males having a higher chance for having a successful DCC than females.

3.2.2 Quality of life

At follow-up, quality of life was compared between patients who underwent a successful DCC (n=36) and patients in which the electrical cardioversion was not successful (n=4). No significant differences were observed with regard to all the various items of the SF-36 questionnaire (Table 11, see Appendix). The same was detected when comparing the quality of life before and after DCC within these groups. In addition, no significant difference was found in the results of the SF-36 questionnaire between patients who were in normal sinus rhythm at follow-up (n=23) and patients in which AF or atrial flutter was present as documented on ECG (n= 14) (Table 12, see Appendix). When comparing quality of life of all 42 AF patients at baseline and at follow-up, no statistical significant differences were detected in any of the SF-36 items (Figure 5). However, the median percentage of score for the SF-36 item related to RP was increased at follow-up, but did not reach statistical significant values (50.0% (IQR 81.25) at baseline vs. 87.5% (IQR 75.00) at follow-up, P=0.052)(Table 13, see Appendix).

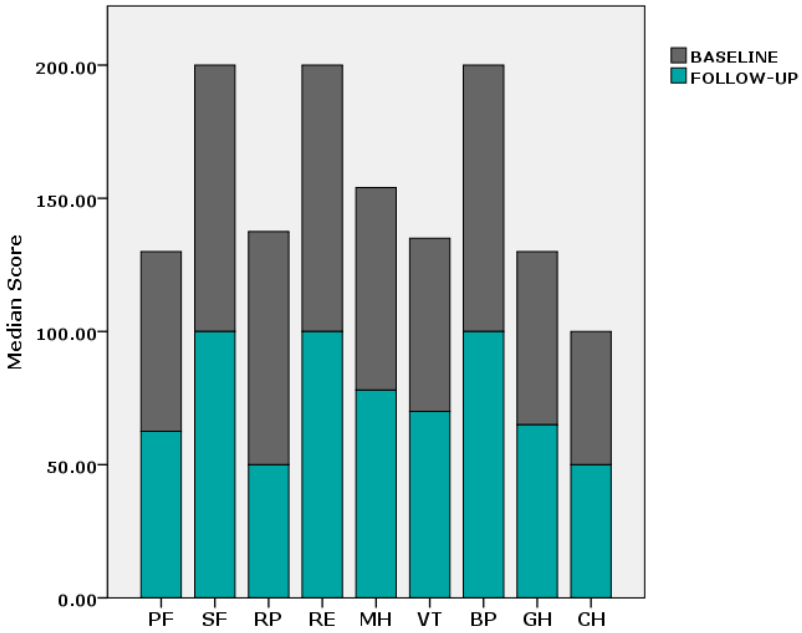

Figure 5: Patient's quality of life at baseline and at follow-up (n=42). A P-value <0.05 was considered a statistically significant difference. No statistical differences in median percentage of score were observed (P>0.05). *PF* physical functioning; *SF* social functioning; *RP* role limitations due to physical health problems; *RE* role limitations due to emotional problems; *MH* mental health; *VT* vitality; *BP* bodily pain; *GH* general health perceptions; *CH* change in health.

Table 3: Comparison of the medication prescribed at baseline, after electrical cardioversion, and at follow-up for all 42 AF patients.

Type of medication – n (%)	Baseline medication (n=42)	Post-DCC medication (n=42)	Follow-up medication (n=42)	P-value† (baseline vs. post-DCC)	P-value‡ (post-DCC vs. follow-up)
Anti-aggregation therapy	15 (35.7)	10 (23.8)	7 (16.7)	**0.025***	0.257
Anticoagulation therapy	24 (57.1)	21 (100)	38 (90.5)	**<0.001***	**0.046***
LMWH	6 (14.3)	7 (16.7)	2 (4.8)	0.317	**0.025***
NOAC	13 (31.0)	27 (64.3)	27 (64.3)	**<0.001***	1
Coumarin	6 (14.3)	8 (19.0)	9 (21.4)	0.157	0.317
Rate control					
β-blockers	25 (59.5)	28 (66.7)	26 (61.9)	0.083	0.317
CAA: Non-dihydropiridines	3 (7.1)	5 (11.9)	7 (16.7)	0.157	0.317
Digitalis	2 (4.8)	1 (2.4)	0 (0.0)	0.317	0.317
Antihypertensive drugs					
CAA: dihydropiridines	9 (21.4)	10 (23.8)	8 (19.0)	0.317	0.157
ACE-I	11 (26.2)	13 (31.0)	16 (38.1)	0.157	0.180
ARB	5 (11.9)	6 (14.3)	6 (14.3)	0.317	1
Diuretics	15 (35.7)	17 (40.5)	16 (38.1)	0.414	0.564
Antiarrhythmic drugs				0.002	
Amiodaron	6 (14.3)	11 (26.2)	13 (31.0)	**0.025***	0.420
Flecainide	6 (14.3)	11 (26.2)	10 (23.8)	0.059	0.655
Statins	15 (35.7)	17 (40.5)	17 (40.5)	0.157	1

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation; *DCC* direct-current cardioversion; *LMWH* low-molecular weight heparin; *NOAC* novel oral anticoagulants for atrial fibrillation; *CAA* calcium antagonist; *ACE-I* angiotensin-converting-enzyme inhibitor; *ARB* angiotensin II receptor blocker.
† Comparison between baseline and post-DCC medication
‡ Comparison between post-DCC and follow-up medication

3.3 Medication

The type of medication patients were taking before undergoing DCC (i.e. baseline medication) was not statistically significant different between patients in the education group and patients receiving usual care. The same was observed for the medication prescribed after the electrical cardioversion and at follow-up between both groups. When comparing the medication patients were taking at baseline and after electrical cardioversion for all 42 AF patients (Table 3), a significant decrease was seen in the prescription of anti-aggregation therapy post-DCC (35.7% vs. 23.8%, P=0.025). In addition, anticoagulation therapy was prescribed in all patients after DCC (57.1% at baseline vs. 100% post-DCC, P<0.001), with the number of patients taking Novel Oral Anticoagulants for AF (NOAC) being doubled (31% vs. 64.3%, P<0.001). Furthermore, the amount of antiarrhythmic drugs was significantly increased post-DCC (P=0.002), but only a significant difference was found in amiodarone (14.3% pre- vs. 26.2% post-DCC, P=0.025), while a positive trend was seen in the prescription of flecainide (14.3% pre- vs. 26.2% post-DCC, P=0.059). No statistical differences were observed in medication prescribed post-DCC between patients in which the cardioversion was successful (n=36) and patients in which DCC was not successful (n=4), nor between patients who underwent DCC (n=40) and patients who did not (n=2).

When comparing the medication patients had to take after undergoing DCC (post-DCC medication) and the medication that was prescribed after follow-up consultation, a significant decrease was observed in the number of patients taking low-molecular weight heparin (LMWH) at follow-up (14.3% vs. 4.8%, P=0.046) (Table 3). Moreover, the amount of total anticoagulant drugs was significantly lower at follow-up compared to post-DCC (100% vs. 90.5% P=0.046). Furthermore, the medication prescribed at follow-up consultation did not significantly differ between patients in which AF was documented on ECG and patients who were in normal sinus rhythm (Table 14, See Appendix). A significant correlation was found between patients having a CHA_2DS_2-VASC score ≥2 and the prescription of anticoagulant drugs at follow-up (P=0.001, R^2=0.513), with all patients having a CHA_2DS_2-VASC score ≥2 receiving anticoagulation therapy (n=30) (Figure 6).

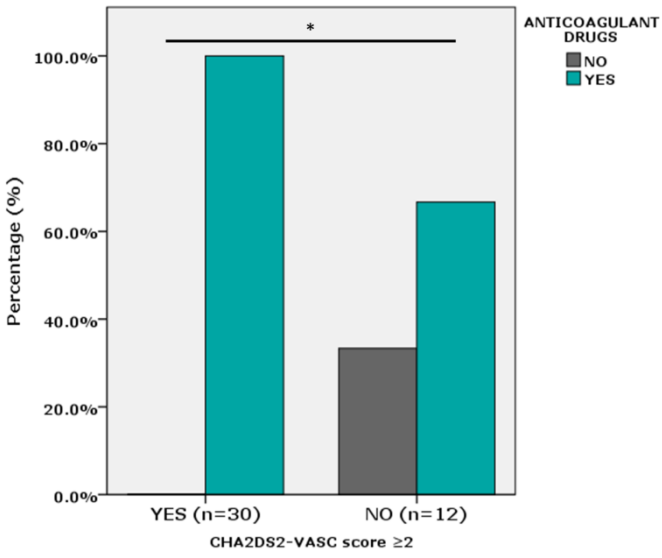

Figure 6: Correlation between a CHA2DS2-VASC score ≥2 and the prescription of anticoagulant drugs after follow-up consultation. A p-value <0.05 was considered a statistically significant difference (*). n: sample size. CHA2DS2-VASc congestive heart failure, hypertension, age 75 years or older, diabetes mellitus, previous stroke /transient ischemic attack (TIA)/ thromboembolism (TE), vascular disease, age between 65 and 74 years, and female sex. Each risk factor counts as one point, except for age ≥ 75 years and the stroke/TIA/TE risk factor, which count as two points.

No correlation was found between the medication that was prescribed post-DCC and whether AF was present at follow-up. The same was observed with regard to a correlation between the presence of AF at follow-up and gender, age, BMI, duration of follow-up, history of AF, type of AF, previous DCC attempts, previous ablation procedures, and the success rate of DCC. A negative trend was seen between patients with lone AF and the presence of AF documented on ECG at follow-up, with patients having no other comorbidities except for AF showing a higher chance for being in normal sinus rhythm at follow-up (P=0.091, R^2=-0.282). On the other hand, patients with CAD (P=0.001, R^2=0.533) and/or HF (P=0.036, R^2=0.349) showed a positive correlation with AF being present at follow-up.

3.4 Questionnaire results at baseline

The number and percentages of AF patients reporting correct responses to each question of the questionnaires related to AF knowledge, DCC knowledge, and self-management activities at baseline are summarized in Table 4. In addition, baseline results of the five-point Likert attitude scale are depicted in Table 5. Percentages of patient's overall baseline scores on the aforementioned questionnaires are shown in Figure 7, more detailed information regarding these results can be found in Table 15 (see Appendix).

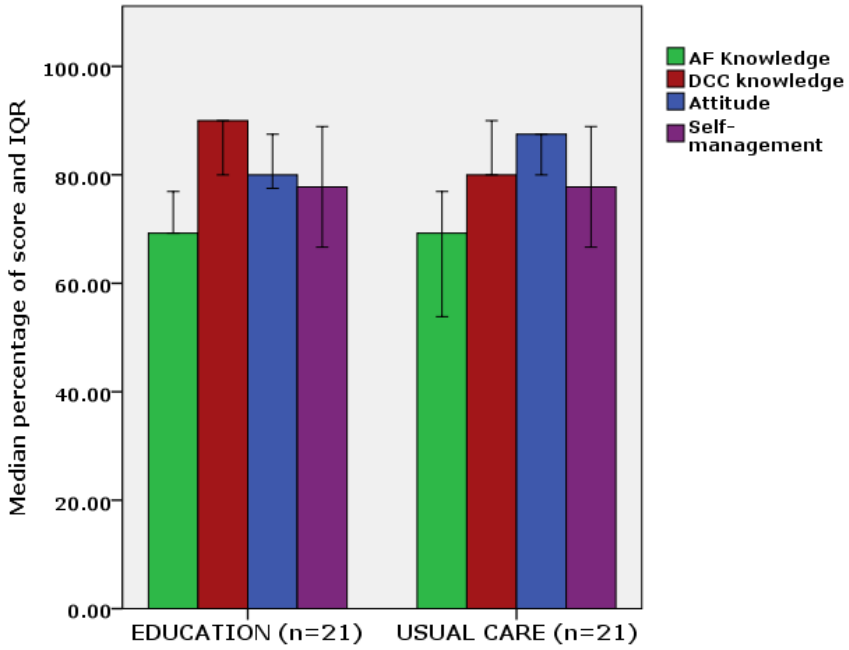

Figure 7: Patient's overall baseline scores related to knowledge of AF, knowledge of DCC, attitude regarding AF, and self-management activities. Median percentage of score and interquartile range (IQR) are shown. No significant differences were found between the education group and the control group. A p-value <0.05 was considered a statistically significant difference. *AF* atrial fibrillation; *DCC* direct-current cardioversion

3.4.1 Knowledge of AF

The overall median percentage of score on the knowledge of AF questionnaire did not differ between the education group and the control group at baseline and was approximately 70% in both groups (Figure 7). However, the percentage of patients reporting correct responses related to the

importance of taking their medication for AF properly was significantly higher in the education group compared with the usual care group (76.2% vs. 42.9% respectively, P=0.028). Furthermore, the overall number of correct responses was low for knowledge regarding the problems of untreated AF (38.1% in both groups), the different treatment modalities of AF (42.9% in both groups), and the side-effects of taking anticoagulant drugs (33.3% in the education group and 57.1% in the usual care group) (Table 4).

3.4.1 Knowledge of DCC

The overall median percentage of score with respect to knowledge of DCC at baseline was high and did not statistically differ among both study groups (90% (IQR 10) in the education group vs. 80% (IQR 15) in the control group)(Figure 7). Nonetheless, only 52.4% of patients knew that the success rate of DCC cannot reach 100% for all cases (Table 4).

3.4.2 Self-management activities

Patient's overall contribution in their self-management activities was the same between the education group and the control group at baseline (77.78% (IQR 22.22)) (Figure 7). However, only 28.6% of patients reported to monitor their pulse on a daily basis (Table 4). One value was missing in the education group for question numbers one to five (Q1-Q5), since one patient never had to take any medication in his life before.

3.4.1 Attitude regarding AF

The median percentage of the total score on the attitude scale was at least 80% for both groups (Figure 7). Patient's baseline score range regarding whether or not patients agree that it is important to monitor their pulse regularly in order to detect asymptomatic AF episodes in an early stage significantly differed between the education group and the control group (P<0.001). 61.9% of patients in the control group totally agreed, 9.5% agreed, 14.3% were neutral, and 14.3% disagreed. In contrast, the analogous percentages among those in the education group were 9.5%, 47.6%, 38.1%, and 4.8% (Table 5).

3.4.1 Quality of life

When patients were contacted for participation of the study, their quality of life was assessed for the first time using the SF-36 questionnaire (baseline quality of life). At this time point, none of the various items of the questionnaire varied between the two groups.

Table 4: Number and percentage of correct responses related to knowledge of AF, knowledge of DCC, and self-management activities at baseline.

Questionnaire	EDUCATION (n=21)	USUAL CARE (n=21)	P-value
	Correct response (%)	Correct response (%)	
Knowledge of AF			
Q1: What is AF	20 (95.2)	20 (95.2)	1
Q2: AF is rare condition	14 (66.7)	9 (42.9)	0.121
Q3: What are the symptoms of AF	20 (95.2)	21 (100)	1
Q4: What are the trigger factors for AF	18 (85.7)	17 (81.0)	1
Q5: It is particularly risky if a person does not feel his/her AF	13 (61.9)	16 (76.2)	0.317
Q6: Statements regarding physical exercise of patients with AF	19 (90.5)	14 (66.7)	0.130
Q7: Statements regarding to the level of danger associated with AF	18 (85.7)	16 (76.2)	0.697
Q8: Why is it important to take my medication for AF properly	16 (76.2)	9 (42.9)	**0.028***
Q9: Why is anticoagulation medication prescribed in certain AF patients	16 (76.2)	20 (95.2)	0.184
Q10: Why should a person using anticoagulation medication be careful with the use of alcohol	15 (71.4)	14 (66.7)	0.739
Q11: Do you know what types of problems untreated AF can cause? (Yes/No)	8 (38.1)	8 (38.1)	1
Q12: Do you know therapeutic strategies of AF? (Yes/No)	9 (42.9)	9 (42.9)	1
Q13: Do you know if there are any side effects of taking anticoagulant drugs? (Yes/No)	7 (33.3)	12 (57.1)	0.121
Knowledge of DCC			
Q1: The treatment efficacy of DCC can reach 100%	11 (52.4)	11 (52.4)	1
Q2: In normal conditions, the patient is allowed to go home after successful DCC	19 (90.5)	19 (90.5)	1
Q3: The patient is allowed to drive a vehicle during the first 24h after DCC	16 (76.2)	17 (81.0)	1
Q4: There is high chance for AF recurrence after successful DCC	20 (95.2)	17 (81.0)	0.343
Q5: There are no complications related to DCC if the patient takes anticoagulation medication a few weeks in advance (if prescribed by the physician)	16 (76.2)	15 (71.4)	0.726
Q6: The patient is allowed to eat and drink before DCC takes place	18 (85.7)	18 (85.7)	1
Q7: The goal of DCC is to terminate the arrhythmia	21 (100)	20 (95.2)	1
Q8: After successful DCC, the patient does not need to take medication anymore	18 (85.7)	19 (90.5)	1
Q9: Before DCC, a TEE examination can be performed	15 (71.4)	16 (76.2)	0.726
Q10: The patient will be sedated during DCC	19 (90.5)	20 (95.2)	1

Self-management activities			
Q1: Do you sometimes forget to take your medication?	18 (90.0) [a]	15 (71.4)	0.238
Q2: Have you ever reduced the dosage of your medication without requesting your physician?	19 (95.0) [a]	20 (95.2)	1
Q3: Do you sometimes forget to take your medication with you?	19 (95.0) [a]	21 (100)	0.488
Q4: Have you ever stopped taking your medication without requesting your physician?	20 (100) [a]	21 (100)	1
Q5: Do you think taking medication on a schedule is troublesome?	19 (95.0) [a]	18 (85.7)	0.606
Q6: Do you restrict alcohol intake?	16 (76.2)	17 (81.0)	1
Q8: Do you aim at losing weight according to your AF condition?	14 (66.7)	14 (66.7)	1
Q9: Do you monitor your pulse daily?	6 (28.6)	6 (28.6)	1
Q10: Do you do appropriate exercise according to your AF condition?	14 (66.7)	15 (71.4)	0.739

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*).
[a] one missing value (n=20) *AF* atrial fibrillation; *DCC* direct-current cardioversion; *TEE* Transoesophagal echocardiography

Table 5: Results of the five-point Likert attitude scale at baseline.

PRE-DCC	**Education (n=21)**					**Usual care (n=21)**					**P-value**
	Score n (%)					**Score n (%)**					
Item	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
Q1	0 (0)	8 (38.1)	3 (14.3)	5 (23.8)	5 (23.8)	0 (0)	1 (4.8)	4 (19)	7 (33.3)	9 (42.9)	0.070
Q2	0 (0)	2 (9.5)	0 (0)	6 (28.6)	13 (61.9)	0 (0)	0 (0)	2 (9.5)	5 (23.8)	14 (66.7)	0.422
Q3	3 (14.3)	1 (4.8)	5 (23.8)	6 (28.6)	6 (28.6)	0 (0)	5 (23.8)	5 (23.8)	7 (33.3)	4 (19)	0.210
Q4	0 (0)	0 (0)	0 (0)	10 (47.6)	11 (52.4)	1 (4.8)	0 (0)	4 (19)	9 (42.9)	7 (33.3)	0.099
Q5	1 (4.8)	3 (14.3)	3 (14.3)	6 (28.6)	8 (38.1)	0 (0)	0 (0)	3 (14.3)	8 (38.1)	10 (47.6)	0.427
Q6	0 (0)	0 (0)	0 (0)	6 (28.6)	15 (71.4)	0 (0)	0 (0)	1 (4.8)	6 (28.6)	14 (66.7)	1
Q7	1 (4.8)	0 (0)	0 (0)	2 (9.5)	18 (85.7)	2 (9.5)	0 (0)	0 (0)	3 (14.3)	16 (76.2)	0.740
Q8	0 (0)	1 (4.8)	8 (38.1)	10 (47.6)	2 (9.5)	0 (0)	3 (14.3)	3 (14.3)	2 (9.5)	13 (61.9)	**<0.001***

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation. Q1: I think AF is a serious disease; Q2: I think AF will affect my quality of life if not treated; Q3: I am afraid of the complications of AF; Q4: Good adherence to a prescribed medication and/or lifestyle regimen can reduce uncomfortable symptoms caused by AF; Q5: If there is no embolic complication, it is unnecessary to take anticoagulant drugs; Q6: It is a waste of time for periodic follow-up; Q7: The guidance of the medical staff is more reliable than the information provided by newspaper, television or other media; Q8: I should monitor my pulse regularly in order to detect asymptomatic AF episodes in an early stage

3.4.2 Correlations patient characteristics – knowledge levels

The different patient characteristics that are summarized in Table 2 (BMI, age, gender, education level, occupational status, marital status, smoking status, alcohol usage, caffeine usage, history of AF, type of AF, duration of AF, previous DCC attempts, previous ablation procedures, EHRA score, medication, and co-morbidities) were tested for possible correlations with the overall scores of the different questionnaires. A positive trend was seen towards higher baseline scores on the knowledge of AF (P=0.053) and the knowledge of DCC questionnaire (P=0.053) in patients having a higher educational level completed. Furthermore, a positive correlation was observed between the baseline knowledge patients have regarding AF and the way of hospital admission, with patients presenting via consultation having a higher knowledge level of AF than patients presenting via emergency ward (P=0.031, R^2=0.333). Patient's smoking status (P=0.030, R^2=0.336) showed a significant correlation with the attitude patients have regarding AF, with patients who have never smoked having a more positive attitude towards their disease (i.e. showed higher scores on the attitude scale at baseline). In addition, patients who have no other co-morbidities apart from AF (i.e. lone AF) appeared to have a better contribution in self-management activities (P=0.019, R^2=0.362). Furthermore, patients who drink no alcohol or less than three glasses/week show higher scores on the self-management questionnaire, however this trend was not statistically significant (P=0.056).

3.5 Evaluation education

All 21 patients who received patient education reported that the educational intervention had increased their knowledge regarding their disease and that the verbal information that was provided was clear. The scores patients gave to each item of the educational intervention are shown in Table 6. The majority of the patients gave a score of 4 'very good' or 5 'excellent' to each item. The educational intervention had an overall mean score of 14.71 ± 1.74 on a maximum score of 17, which equivalents a mean percentage of 86.56%.

Table 6: Evaluation of the educational intervention of 21 AF patients.

	Score – n (%)				
Item	**1**	**2**	**3**	**4**	**5**
Verbal information	0 (0)	0 (0)	1 (4.8)	10 (47.6)	10 (47.6)
AF booklet	0 (0)	0 (0)	5 (23.8)	7 (33.3)	9 (42.9)
DCC booklet	0 (0)	0 (0)	4 (19.0)	11 (52.4)	6 (28.6)

Data are presented as number of patients and percentage. n: sample size. Score 5 'excellent'; score 4 'very good'; score 3 'good'; score 2 'moderate'; score 1 'bad'. *AF* atrial fibrillation; *DCC* direct-current cardioversion

3.6 Questionnaire results at follow-up

3.6.1 Education vs. usual care

At follow-up, no statistically significant differences were seen in patient's overall score with respect to knowledge of AF, knowledge of DCC, attitude regarding AF, and self-management activities between the education group and the patients who received usual care (Figure 8). Detailed information regarding these scores are summarized in Table 16 (see Appendix).

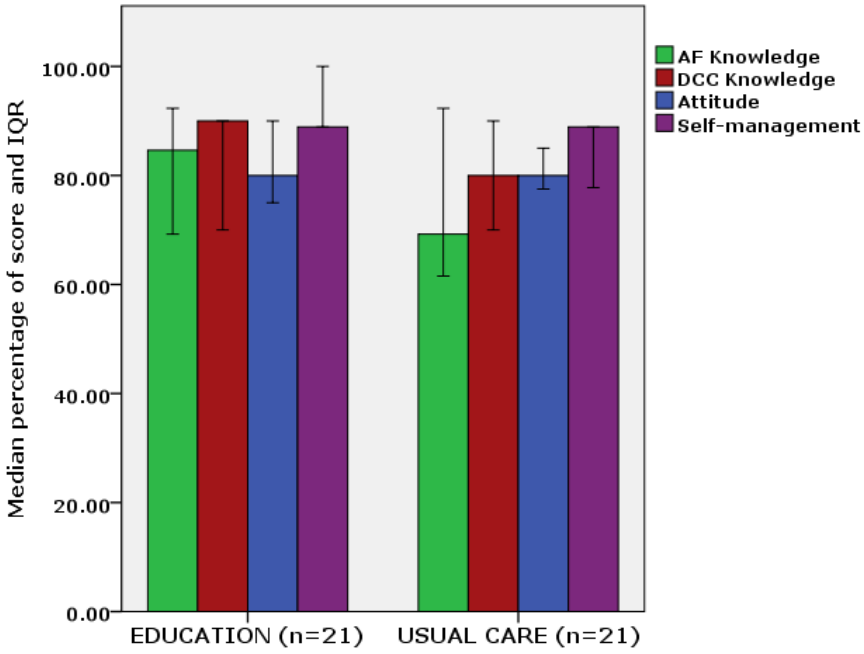

Figure 8: Patient's overall levels related to knowledge of AF, knowledge of DCC, attitude regarding, and self-management activities between the education group (n=21) and the usual care group (n=21) at follow-up. Median percentage of score and interquartile range (IQR) are shown. A p-value <0.05 was considered a statistically significant difference. No significant differences were found between the education group and the control group. *AF* atrial fibrillation; *DCC* direct-current cardioversion

A positive trend was observed towards higher scores related to knowledge of AF for patients in the education group (80.95% ± 16.07 in the education group vs. 71.43% ± 17.73 in the usual care group, P=0.076), but showed no statistically significance (Table 16, see Appendix). However, the number of patients reporting correct responses related to AF being common was significantly higher in the education group than in the control group (90.5% vs. 42.9% respectively, P=0.001) (Table 17, see Appendix). No statistical significant differences were seen in the number of patients reporting correct responses with regard to the knowledge of DCC or self-management activities between both groups at follow-up (Table 17, see Appendix). Furthermore, patient's score range on the attitude scale was not different between the education group and usual care group at follow-up (Table 18, see Appendix), as was the case for the results of the SF-36 questionnaire assessing patient's quality of life.

3.6.2 Pre- vs. post-education

When comparing the overall knowledge levels of patients assigned to the education group before and after they received education, a significant increase was observed in patient's knowledge of AF (69.23% (IQR 11.53) before vs. 84.62% (IQR 19.24) after patient education, P=0.011) and their contribution in self-management activities (77.78% (IQR 22.22) vs. 88.89% (IQR 16.66), P=0.031) post-education (Figure 9). In addition, no statistically significant differences were seen in patient's overall score with respect to knowledge of DCC (90% (IQR 10) vs. 90% (IQR 20)) and attitude regarding AF (81.67% ± 7.09 vs. 81.19% ± 9.34) (Figure 9). Detailed information concerning these overall scores before and after the educational intervention are depicted in Table 19(see Appendix).

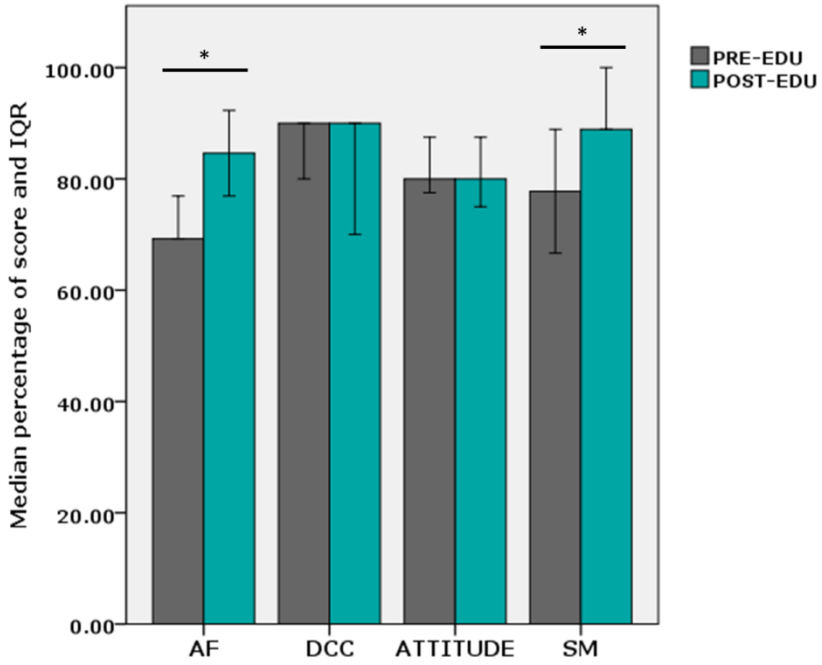

Figure 9: Patient's overall levels with respect to knowledge of AF, knowledge of DCC, attitude regarding AF, and self-management activities before and after receiving patient education (n=21). Median percentage of score and interquartile range (IQR) are shown. A P-value <0.05 was considered a statistically significant difference (*). n: sample size. *EDU* education; *AF* atrial fibrillation; *DCC* direct-current cardioversion; *SM* self-management.

The number and percentage of correct responses to each item of the different questionnaires pre- and post-education are shown in Table 7. The percentage of patients reporting correct responses related to the side effects of taking anticoagulant drugs was significantly higher post-education (33.3% pre- vs. 51.9% post-education, P=0.034). Furthermore, a positive trend was seen in the number of patients knowing that AF is a common disease (66.7% before vs. 90.5% after the education, P=0.059), although no statistical values were reached. In addition, 66.7% of the patients knew different therapeutic strategies after receiving education versus 42.9% at baseline, although this increase was not statistically significant (P=0.059). After receiving education, 95.2% of patients were aware of the fact that a TEE examination can be performed preceding DCC in contrast with 71.4% at baseline (P=0.025). In addition, more patients stated to restrict alcohol intake (76.2% before vs. 95.2% after the education, P=0.046) and to perform appropriate exercise

according to their AF condition (66.7% before vs. 85.7% after the education, P=0.046) at follow-up. When questioned about whether they were afraid of the complications of AF at baseline, 14.3% of patients 'completely disagreed', 4.8% 'disagreed', 23.8 were 'neutral', 28.6% 'agreed', and 28.6% 'completely agreed'. The analogous figures were 19%, 9.5%, 28.6%, 33.3%, and 9.5% after the educational intervention (P=0.026), demonstrating significant change in patient's attitude towards the fear of the complications of AF (Table 8).

In addition, patient's score range related to the importance of monitoring their pulse regularly in order to detect asymptomatic AF episodes in an early stage showed significant differences before (4.8% disagreed, 38.1% were neutral, 47.6% agreed and 9.5% completely agreed at baseline) and after patient education (4.8% disagreed, 19% were neutral, 33.3% agreed, and 42.9% completely agreed) (P=0.045), with a positive shift towards more patients completely agreeing that this is important (score 5) (Table 8).

3.6.1 Pre- vs. post-usual care

When patients assigned to the control group completed the questionnaires at follow-up, a significant decrease was detected with respect to patient's overall attitude levels regarding AF (87.50% (IQR 8.75) at baseline vs. 80% (IQR 8.75) at follow-up, P=0.043)(Figure 10). No statistically significant difference was seen in patient's overall median percentage of score related to knowledge of AF (67.77% ± 19.70 vs. 71.43% ± 17.73), knowledge of DCC (81.90% ± 10.78 vs. 75.71% ± 19.89), and self-management activities (77.78% (IQR 22.22) vs. 88.89% (IQR 11.11)) before and after usual care, respectively (Figure 10). Detailed information concerning these overall scores at baseline and follow-up are depicted in Table 20 (see Appendix).

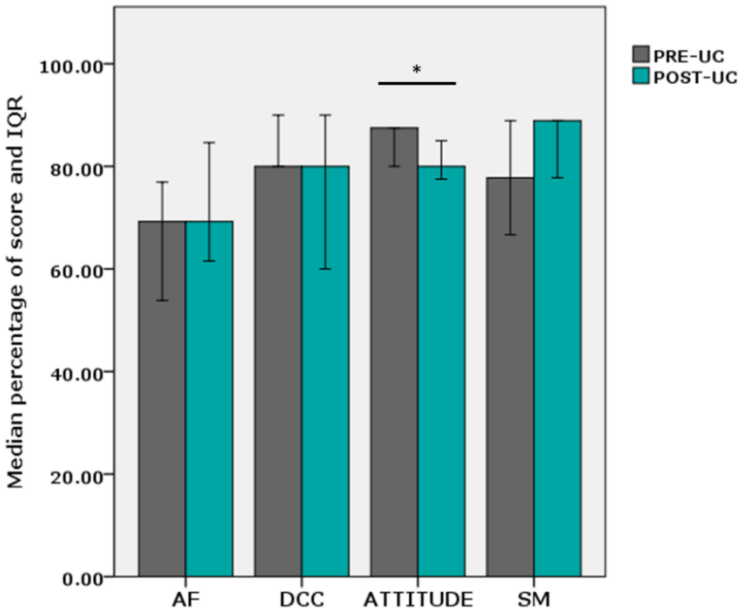

Figure 10: Patient's overall levels with respect to knowledge of AF, knowledge of DCC, attitude regarding AF, and self-management activities before and after receiving usual care for patients in the control group (n=21). Median percentage of score and interquartile range (IQR) are shown. A p-value <0.05 was considered a statistically significant difference (*). n: sample size. *UC* usual care; *AF* atrial fibrillation; *DCC* direct-current cardioversion; *SM* self-management

Table 7: Number and percentage of correct responses related to knowledge of AF, knowledge of DCC, and self-management activities before and after patient education.

Questionnaire	PRE-EDUCATION (n=21)	POST-EDUCATION (n=21)	P-value
	Correct response (%)	Correct response (%)	
Knowledge of AF			
Q1: What is AF	20 (95.2)	21 (100)	0.317
Q2: AF is rare condition	14 (66.7)	19 (90.5)	0.059
Q3: What are the symptoms of AF	20 (95.2)	20 (95.2)	1
Q4: What are the trigger factors for AF	18 (85.7)	19 (90.5)	0.564
Q5: It is particularly risky if a person does not feel his/her AF	13 (61.9)	17 (81)	0.102
Q6: Statements regarding physical exercise of patients with AF	19 (90.5)	19 (90.5)	1
Q7: Statements regarding to the level of danger associated with AF	18 (85.7)	18 (85.7)	1
Q8: Why is it important to take my medication for AF properly	16 (76.2)	15 (71.4)	0.564
Q9: Why is anticoagulation medication prescribed in certain AF patients	16 (76.2)	19 (90.5)	0.180
Q10: Why should a person using anticoagulation medication be careful with the use of alcohol	15 (71.4)	14 (66.7)	0.705
Q11: Do you know what types of problems untreated AF can cause? (Yes/No)	8 (38.1)	13 (51.9)	0.132
Q12: Do you know therapeutic strategies of AF? (Yes/No)	9 (42.9)	14 (66.7)	0.059
Q13: Do you know if there are any side effects of taking anticoagulant drugs? (Yes/No)	7 (33.3)	13 (51.9)	**0.034***
Knowledge of DCC			
Q1: The treatment efficacy of DCC can reach 100%	11 (52.4)	8 (38.1)	0.257
Q2: In normal conditions, the patient is allowed to go home after successful DCC	19 (90.5)	21 (100)	0.157
Q3: The patient is allowed to drive a vehicle during the first 24h after DCC	16 (76.2)	15 (71.4)	0.655
Q4: There is high chance for AF recurrence after successful DCC	20 (95.2)	19 (90.5)	0.564
Q5: There are no complications related to DCC if the patient takes anticoagulation medication a few weeks in advance (if prescribed by the physician)	16 (76.2)	15 (71.4)	0.739
Q6: The patient is allowed to eat and drink before DCC takes place	18 (85.7)	15 (71.4)	0.257
Q7: The goal of DCC is to terminate the arrhythmia	21 (100)	20 (95.2)	0.317
Q8: After successful DCC, the patient does not need to take medication anymore	18 (85.7)	20 (95.2)	0.317
Q9: Before DCC, a TEE examination can be performed	15 (71.4)	20 (95.2)	**0.025***
Q10: The patient will be sedated during DCC	19 (90.5)	20 (95.2)	0.564

Self-management activities			
Q1: Do you sometimes forget to take your medication? (Yes/No)	18 (90.0) [a]	19 (90.5)	1
Q2: Have you ever reduced the dosage of your medication without requesting your physician?	19 (95.0) [a]	20 (95.2)	1
Q3: Do you sometimes forget to take your medication with you?	19 (95.0) [a]	20 (95.2)	1
Q4: Have you ever stopped taking your medication without requesting your physician?	20 (100) [a]	20 (95.2)	0.317
Q5: Do you think taking medication on a schedule is troublesome?	19 (95.0) [a]	21 (100)	0.317
Q6: Do you restrict alcohol intake?	16 (76.2)	20 (95.2)	**0.046***
Q8: Do you aim at losing weight according to your AF condition?	14 (66.7)	16 (76.2)	0.157
Q9: Do you monitor your pulse daily?	6 (28.6)	8 (38.1)	0.480
Q10: Do you do appropriate exercise according to your AF condition?	14 (66.7)	18 (85.7)	**0.046***

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*).
[a] one missing value (n=20) *AF* atrial fibrillation; *DCC* direct-current cardioversion; *TEE* Transoesophagal echocardiography

Table 8: Results of the five-point Likert attitude scale of the education group before and after the educational intervention

POST-DCC	**Pre-Education (n=21)**					**Post-Education (n=21)**					**P-value**
	Score n (%)					**Score n (%)**					
Item	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
Q1	0 (0)	8 (38.1)	3 (14.3)	5 (23.8)	5 (23.8)	0 (0)	6 (28.6)	7 (33.3)	5 (23.8)	3 (14.3)	0.637
Q2	0 (0)	2 (9.5)	0 (0)	6 (28.6)	13 (61.9)	0 (0)	1 (4.8)	0 (0)	11 (52.4)	9 (42.9)	0.564
Q3	3 (14.3)	1 (4.8)	5 (23.8)	6 (28.6)	6 (28.6)	4 (19)	2 (9.5)	6 (28.6)	7 (33.3)	2 (9.5)	**0.026***
Q4	0 (0)	0 (0)	0 (0)	10 (47.6)	11 (52.4)	0 (0)	0 (0)	0 (0)	7 (33.3)	14 (66.7)	0.317
Q5	1 (4.8)	3 (14.3)	3 (14.3)	6 (28.6)	8 (38.1)	1 (4.8)	2 (9.5)	3 (14.3)	9 (42.9)	6 (28.6)	0.894
Q6	0 (0)	0 (0)	0 (0)	6 (28.6)	15 (71.4)	0 (0)	0 (0)	0 (0)	9 (42.9)	12 (57.1)	0.180
Q7	1 (4.8)	0 (0)	0 (0)	2 (9.5)	18 (85.7)	0 (0)	0 (0)	0 (0)	7 (33.3)	14 (66.7)	0.527
Q8	0 (0)	1 (4.8)	8 (38.1)	10 (47.6)	2 (9.5)	0 (0)	1 (4.8)	4 (19)	7 (33.3)	9 (42.9)	**0.045***

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation
Q1: I think AF is a serious disease; Q2: I think AF will affect my quality of life if not treated; Q3: I am afraid of the complications of AF; Q4: Good adherence to a prescribed medication and/or lifestyle regimen can reduce uncomfortable symptoms caused by AF; Q5: If there is no embolic complication, it is unnecessary to take anticoagulant drugs; Q6: It is a waste of time for periodic follow-up; Q7: The guidance of the medical staff is more reliable than the information provided by newspaper, television or other media; Q8: I should monitor my pulse regularly in order to detect asymptomatic AF episodes in an early stage

The number and percentage of patients reporting correct responses to each item of the different questionnaires before and after receiving usual care are shown in Table 9. A significant increase was observed in the number of patients reporting correct responses related to the importance of taking their medication for AF properly, with nine patients giving a correct response at baseline and fifteen patients at follow-up (42.9% vs. 71.4%, P=0.034). Moreover, at follow-up, less patients admitted to forget to take their medication sometimes compared to baseline levels (28.6% vs. 4.8%, P=0.025). When comparing the score levels related to knowledge of DCC of patients in the control group before and after receiving usual care, a significant decrease was observed in the number of patients reporting correct responses with regard to whether or not they are able to eat before undergoing DCC (85.7% vs. 57.1%, P=0.034).

When looking at patient's score range on the attitude scale related to whether or not patients find it necessary to take their anticoagulant drugs if there is no embolic complication, an increase was seen in the number of patients agreeing that it is unnecessary (0% at baseline vs. 19% at follow-up), while the number of patients completely disagreeing was lower at follow-up (47.6% vs. 19%, P=0.007)(Table 10). Furthermore, 14.3% of patients disagreed that they should monitor their pulse regularly in order to detect asymptomatic AF episodes in an early stage at baseline, while 14.3% were neutral, 9.5% agreed, and 61.9% completely agreed. The analogous figures at follow-up were 19%, 23.8%, 23.8%, and 28.6%. In addition, one patient completely disagreed with this attitude item at follow-up (P=0.027), showing a change towards patients finding this less important post-DCC (Table 10). This was reflected in the number of patients who monitor their pulse daily, which was still low at follow-up (33.3% at follow-up vs. 28.6% at baseline) (Table 9).

Table 9: Number and percentage of correct responses related to knowledge of AF, knowledge of DCC, and self-management activities before and after usual care.

Questionnaire	PRE-USUAL CARE (n=21)	POST-USUAL CARE (n=21)	P-value
	Correct response (%)	Correct response (%)	
Knowledge of AF			
Q1: What is AF	20 (95.2)	18 (85.7)	0.157
Q2: AF is rare condition	9 (42.9)	9 (42.9)	1
Q3: What are the symptoms of AF	21 (100)	20 (95.2)	0.317
Q4: What are the trigger factors for AF	17 (81.0)	18 (85.7)	0.564
Q5: It is particularly risky if a person does not feel his/her AF	16 (76.2)	15 (71.4)	0.655
Q6: Statements regarding physical exercise of patients with AF	14 (66.7)	16 (76.2)	0.414
Q7: Statements regarding to the level of danger associated with AF	16 (76.2)	17 (81.0)	0.655
Q8: Why is it important to take my medication for AF properly	9 (42.9)	15 (71.4)	**0.034***
Q9: Why is anticoagulation medication prescribed in certain AF patients	20 (95.2)	19 (90.5)	0.654
Q10: Why should a person using anticoagulation medication be careful with the use of alcohol	14 (66.7)	14 (66.7)	1
Q11: Do you know what types of problems untreated AF can cause? (Yes/No)	8 (38.1)	9 (42.9)	0.655
Q12: Do you know therapeutic strategies of AF? (Yes/No)	9 (42.9)	12 (57.1)	0.257
Q13: Do you know if there are any side effects of taking anticoagulant drugs? (Yes/No)	12 (57.1)	13 (61.9)	0.655
Knowledge of DCC			
Q1: The treatment efficacy of DCC can reach 100%	11 (52.4)	12 (57.1)	0.739
Q2: In normal conditions, the patient is allowed to go home after successful DCC	19 (90.5)	19 (90.5)	1
Q3: The patient is allowed to drive a vehicle during the first 24h after DCC	17 (81.0)	14 (66.7)	0.257
Q4: There is high chance for AF recurrence after successful DCC	17 (81.0)	19 (90.5)	0.317
Q5: There are no complications related to DCC if the patient takes anticoagulation medication a few weeks in advance (if prescribed by the physician)	15 (71.4)	12 (57.1)	0.366
Q6: The patient is allowed to eat and drink before DCC takes place	18 (85.7)	12 (57.1)	**0.034***
Q7: The goal of DCC is to terminate the arrhythmia	20 (95.2)	20 (95.2)	1
Q8: After successful DCC, the patient does not need to take medication anymore	19 (90.5)	17 (81.0)	0.414
Q9: Before DCC, a TEE examination can be performed	16 (76.2)	15 (71.4)	0.317
Q10: The patient will be sedated during DCC	20 (95.2)	19 (90.5)	0.654

Self-management activities			
Q1: Do you sometimes forget to take your medication? (Yes/No)	15 (71.4)	20 (95.2)	**0.025***
Q2: Have you ever reduced the dosage of your medication without requesting your physician?	20 (95.2)	20 (95.2)	1
Q3: Do you sometimes forget to take your medication with you?	21 (100)	20 (95.2)	0.317
Q4: Have you ever stopped taking your medication without requesting your physician?	21 (100)	21 (100)	1
Q5: Do you think taking medication on a schedule is troublesome?	18 (85.7)	18 (85.7)	1
Q6: Do you restrict alcohol intake?	17 (81.0)	18 (85.7)	0.655
Q8: Do you aim at losing weight according to your AF condition?	14 (66.7)	15 (71.4)	0.564
Q9: Do you monitor your pulse daily?	6 (28.6)	7 (33.3)	0.564
Q10: Do you do appropriate exercise according to your AF condition?	15 (71.4)	17 (81.0)	0.157

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*).
[a] one missing value (n=20) *AF* atrial fibrillation; *DCC* direct-current cardioversion; *TEE* Transoesophagal echocardiography

Table 10: Results of the five-point Likert attitude scale of the control group before and after the usual care.

POST-DCC	**PRE-USUAL CARE (n=21)**					**POST-USUAL CARE (n=21)**					**P-value**
	Score n (%)					**Score n (%)**					
Item	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
Q1	0 (0)	1 (4.8)	4 (19)	7 (33.3)	9 (42.9)	0 (0)	3 (14.3)	4 (19)	8 (38.1)	6 (28.6)	0.249
Q2	0 (0)	0 (0)	2 (9.5)	5 (23.8)	14 (66.7)	0 (0)	1 (4.8)	0 (0)	8 (38.1)	12 (57.1)	0.791
Q3	0 (0)	5 (23.8)	5 (23.8)	7 (33.3)	4 (19)	1 (4.8)	2 (9.5)	9 (42.9)	6 (28.6)	3 (14.3)	0.658
Q4	1 (4.8)	0 (0)	4 (19)	9 (42.9)	7 (33.3)	0 (0)	1 (4.8)	1 (4.8)	7 (33.3)	12 (57.1)	0.142
Q5	0 (0)	0 (0)	3 (14.3)	8 (38.1)	10 (47.6)	1 (4.8)	4 (19)	3 (14.3)	9 (42.9)	4 (19)	**0.007***
Q6	0 (0)	0 (0)	1 (4.8)	6 (28.6)	14 (66.7)	0 (0)	1 (4.8)	0 (0)	7 (33.3)	13 (61.9)	0.480
Q7	2 (9.5)	0 (0)	0 (0)	3 (14.3)	16 (76.2)	0 (0)	1 (4.8)	0 (0)	4 (19)	16 (76.2)	0.453
Q8	0 (0)	3 (14.3)	3 (14.3)	2 (9.5)	13 (61.9)	1 (4.8)	4 (19)	5 (23.8)	5 (23.8)	6 (28.6)	**0.027***

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation
Q1: I think AF is a serious disease; Q2: I think AF will affect my quality of life if not treated; Q3: I am afraid of the complications of AF; Q4: Good adherence to a prescribed medication and/or lifestyle regimen can reduce uncomfortable symptoms caused by AF; Q5: If there is no embolic complication, it is unnecessary to take anticoagulant drugs; Q6: It is a waste of time for periodic follow-up; Q7: The guidance of the medical staff is more reliable than the information provided by newspaper, television or other media; Q8: I should monitor my pulse regularly in order to detect asymptomatic AF episodes in an early stage

3.1 Follow-up questionnaire

The mean duration of the follow-up period (i.e. the time between patients underwent DCC and their next follow-up consultation) was 4.62 ± 1.65 weeks and was not statistically different between patients in the education group (4.29 ± 1.82 weeks) and patients in the control group (4.95 ± 1.43 weeks). In addition, the follow-up duration showed no significant correlations with the follow-up results of the various questionnaires.

At follow-up, patients were asked if they had forgotten to take their medication once and/or several times in the period between post-DCC and follow-up consultation. Three patients of the education group and four patients of the control group admitted to have forgotten to take their medication once, while one patient in both groups had forgotten to take their medication several times. Nonetheless, no significant correlation was found related to the presence of AF at follow-up in patients who had forgotten to take their medication once and/or several times. However, a negative significant correlation was found between patients who admitted to have forgotten to take their medication once and/or several times during follow-up period and the scores they achieved on the self-management questionnaire at follow-up ($P=0.021$, $R^2=-0.354$), with the results being lower for these patients.

Patients assigned to the education group were asked if they had read the information booklets in between the follow-up period. Of the 21 patients who received patient education, 15 (71.4%) stated to have read the information booklets one more time, while the other six patients (28.6%) had not. However, no significant differences in any of the knowledge questionnaires were found between these patient groups. Two patients in the education group admitted to have general memory problems (cognitive deficits), hence, a trend was observed towards lower follow-up knowledge levels related to AF in these patients ($P=0.055$, $R^2=-0.298$), although not significant.

Eighteen patients had experienced symptoms of AF post-DCC, but only three patients (two in the usual care group and one in the education group) consulted a health care provider during the follow-up period with regard to their arrhythmia. No correlation was found between patients who experienced symptoms and/or patients who consulted a health care provider and the group these patients were assigned to.

At follow-up, only five patients had searched for more information about AF during the follow-up period. However, no correlation was found with respect to whether these patients had received patient education or the results they scored on the different knowledge questionnaires at follow-up. On the contrary, a significant correlation was observed between patients who had searched for more information and patients who consulted a health care provider during the follow-up period ($P=0.002$, $R^2=0.469$).

3.2 Patient characteristics at follow-up

3.2.1 Non-cardiovascular risk factors

Patient's characteristics with respect to non-cardiovascular risk factors (smoking status, alcohol usage, and caffeine usage) and EHRA score were not significantly different between the education group and control group at follow-up (Table 21, see Appendix). When looking at the EHRA score for all 42 AF patients at baseline and follow-up, a significantly increase was seen in the number of patients reporting no symptoms (EHRA score of 1) (P<0.001)(Figure 11).

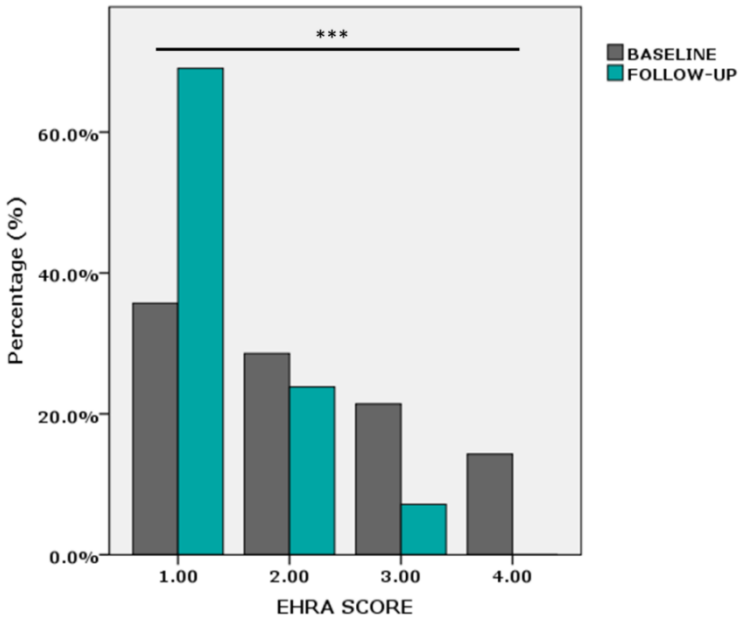

Figure 11: Patient's EHRA score at baseline and follow-up for all 42 AF patients. A statistical significant difference was observed with a P-value<0.001 (***). *EHRA score* European Heart Rhythm Association score of AF-related symptoms.

Furthermore, the alcohol usage was statistically different between baseline and follow-up for patients in the education group (P=0.020) and patients assigned to the usual care group (P=0.008), with the alcohol usage being lower for both groups at follow-up (Table 22, see Appendix).

3.2.2 Smoking status

Five patients of the total study population were smokers at baseline (Table 2). None of these patients knew the impact of smoking on AF at baseline, but four patients stated to restrict or quit smoking in response to their AF condition. At follow-up, only two patients quit smoking and no differences were observed in their knowledge regarding the impact of smoking on AF (0% vs. 20% at follow-up). However, still all four patients stated to restrict or quit smoking in response to their AF condition.

4 Discussion

This study tended to enhance patient's overall contribution in self-management activities by improving their knowledge of AF and change their perceptions and attitude towards their disease in a positive way. Consequently, patients should be more aware of their disease, which may lead to a faster detection of recurrence of AF after successful DCC.

4.1 Electrical cardioversion

Our success rate of DCC was 90%, which was in accordance with other studies reporting a success rate between 70 and 95% (34, 35). Male AF patients seemed to have a higher chance for successful DCC than female subjects. However, no resemblances related to sex differences in the success rate of DCC were observed in other studies. Relapse into AF occurred in 27.8% after 4.62 ± 1.65 weeks. These figures were significantly lower compared to the literature (30, 35). For example, only 37% of patients maintained sinus rhythm at four weeks post-DCC in the study of Rosenqvist et. al (30). However, whether AF recurrence after successful DCC had occurred at follow-up was unknown in 13.9% of the patients due to lack of ECG documentation. Consequently, this may underestimate the low number of AF recurrence. Instead, these patients were seen at other departments in the hospital, apart from the department of Cardiology, or were met outside the hospital. Several studies reported that the percentage of relapse into AF is especially high during the first weeks (25, 34, 35, 37, 38). However, our study found no correlation between the duration of the follow-up period and recurrence of AF. In addition, no significant correlations were found between a successful DCC or recurrence of AF and the type of AF, duration of AF, previous DCC attempts, age, smoking status, the presence of OSAS, or BMI, although these parameters have previously been demonstrated to be useful factors in predicting DCC outcome by several other studies (4, 30, 34, 35). They showed that a short duration of AF is a positive predictor for the success rate of DCC (30, 34, 35, 38), while previous DCC attempts, smoking, OSAS, and obesity negatively affect the outcome (35). Contradictory results have been reported with regard to older age as a useful predictor of AF recurrence post-DCC (25, 30, 34, 35). Paroxysmal AF was most prevalent in our study, 42.9% were newly diagnosed, and more than half of the patients had never undergone previous DCC attempts or ablation procedures before. Conversely, 66.7% of total patients had a BMI exceeding normal range (BMI>24.9). Taken together, these positive and negative predictors may have voided each other, which may explain why no correlations with a successful DCC or recurrence of AF were found. Furthermore, the duration, and thus the type, of AF was defined as the time between ECG-verified diagnosis of AF and DCC, due to difficulty in establishing the actual duration of the arrhythmia (i.e. since the onset of symptoms of AF). Hence, AF may have been present for a longer period of time than described here. No correlations may have been observed for smoking and OSAS due to the low number of smokers (11.9%) and patients suffering from OSAS (9.5%) in the study population. A significant correlation was found towards a higher chance for maintaining normal sinus rhythm at follow-up in patients with lone AF (R^2=0.282), while the opposite was observed in patients with CAD (R^2=-0.533) or HF (R^2=-0.349). This is related to atrial remodelling, which is negatively affected by underlying heart disease, making the atria more vulnerable for relapses into AF (35, 36). Of the patients in which AF was

documented at follow-up, 35.7% would undergo a catheter ablation procedure and another DCC attempt was made in one patient. In addition, pharmacological cardioversion was prescribed in a few other patients, while for at least 21.4% AF was accepted as permanent.

4.2 Quality of life after DCC

Patient's quality of life was measured by means of the SF-36 questionnaire pre- and post-DCC. Although patients reported to feel better at follow-up, as demonstrated by a significant decrease in their EHRA score, this was not reflected in the levels of the various SF-36 items. Although, a positive trend was observed in the results related to RP, with patients being less limited during physical activities at follow-up (P=0.052). This finding may be explained by the fact that the SF-36 questionnaire is a more generalized health questionnaire which takes different factors (e.g. social, emotional, physical) into account, while the EHRA score only focuses on patient's symptoms related to AF and reduces when sinus rhythm is restored (21). Therefore, it is better not to use the SF-36 questionnaire as a tool for determining whether DCC is beneficial in improving patients symptoms and health status with respect to AF.

4.3 Medication

Some patients have undergone a percutaneous coronary intervention, such as stenting, after their cardioversion, which might explain the decrease in prescription of anti-aggregation therapy (e.g. clopidogrel) that was seen post-DCC in order to decrease the risk of severe bleedings during this intervention (21). Furthermore, all patients had to take anticoagulation therapy post-DCC to prevent the formation of thrombi which may lead to stroke. This was in accordance with the 2014 AHA/ACC/HRS guidelines which state that anticoagulation therapy is recommended for at least four weeks after cardioversion in patients with AF of 48-hour duration or longer, or when the duration of AF is unknown, regardless of the CHA_2DS_2-VASc score (21). In addition, the amount of anti-arrhythmic drugs prescribed post-DCC was significantly higher compared to baseline, since they have shown to be associated with longer maintenance of sinus rhythm after cardioversion, and hence, reduce the chances of relapse into AF (4, 30, 34, 35). For instance, the research group of Longas-Tejero has showed that selecting an effective antiarrhythmic drug therapy in association with DCC may reduce recurrence of AF to 44-67% at one year, while this is almost 71-84% without antiarrhythmic drugs (46). However, no correlation was found between prescription of anti-arrhythmic agents after cardioversion and the presence of AF at follow-up. Hence, the predictive value of these factors is still limited and more research is needed within this field (25).

After a follow-up consultation of approximately four weeks, less patients had to take LMWH compared to post-DCC. This might be attributed to the fact that in patients which had planned to undergo a catheter ablation procedure the prescription of LMWH was suspended to reduce the risk of bleedings. In addition, anticoagulation therapy was no longer considered for nonvalvular AF patients (i.e. AF in the absence of valvular disease) with a CHA_2DS_2-VASc score ≤ 1 at four weeks post-DCC, which was in accordance with the guidelines and explains the significant decrease in anticoagulation therapy observed at follow-up (21). In addition, all patients having a CHA_2DS_2-VASc score ≥ 2 should receive anticoagulation therapy, which was also observed in our study (21).

4.4 Patient education

4.4.1 Baseline knowledge levels

Patient's baseline levels regarding knowledge of AF, knowledge of DCC, attitude towards their disease, and self-management activities were similar between the education group and the control group. There were knowledge deficits with respect to problems/complications of untreated AF, the different treatment modalities of AF, and side effects of anticoagulation therapy. These deficits were also revealed by other researchers (5, 7, 10, 41, 43) and may increase patient's risk for bleeding and/or stroke. In addition, it was striking that only 28.6% of the patients reported to monitor their pulse on a daily basis. This was in accordance with other research, in which 64% did not check their pulse daily (7). However, lack of daily pulse self-examination might delay detection of AF in case of relapse after successful DCC. This may in turn play into the hands of progression of AF to permanent form, making it more difficult to restore normal sinus rhythm (35, 36, 38).

At baseline, patients assigned to the education group reported more correct responses related to the importance of taking their medication for AF properly (i.e. to prevent severe consequences of the arrhythmia) compared to the control group (Q8 of the knowledge of AF questionnaire). However, when questioned about what types of problems untreated AF can cause (Q11 of the knowledge of AF questionnaire) only 38.1% of patients in the education group actually knew that these consequences/problems are stroke and HF, which was the same for the patients in the usual care group. Hence, there is a great probability that many patients in the education group guessed the correct answer related to the importance of taking their medication for AF properly, which may explain this significant difference observed between both groups.

Patient's baseline score range regarding whether or not patients agree that it is important to monitor their pulse regularly in order to detect asymptomatic AF episodes in an early stage significantly differed between the education group and the control group. More patients in the control group completely agreed (61.9% in usual care vs. 9.5% in education group), while the opposite was observed for the number of patients agreeing being higher in the education group (9.5% in usual care vs. 47.6% in education group). However, when summing up the percentages of score 4 ("I agree") and 5 ("I completely agree") for both groups, this significant difference was voided (P=0.520).

Despite the high overall baseline knowledge of DCC, more than half of the patients believed that DCC can reach an efficiency of 100% instead of the correct percentage of 70-95% (34, 35). It is important that patients know these correct numbers in order to make a shared clinical decision about their management (3). Seaburg et. al showed that a shared decision making model in AF management is important in order for patients to understand more accurately their personal risks when engaging in treatment decisions, which may influence their outcome, quality of life, and contribution in self-management activities (3).

Non-smokers showed higher baseline attitude levels towards their disease, since these patients might find their health condition more important than smokers. Hence, more attention is needed to make smokers aware of the impact of smoking on AF and to change their attitude in a positive way.

4.4.2 Patient's knowledge levels at follow-up

✓ ***Education vs. usual care***

At follow-up, no statistically significant differences were found with respect to the total scores on the different questionnaires between patients who received education and patients who received usual care. A positive trend was seen regarding the knowledge of AF being higher in patients who received education. However, a power analysis showed that the sample size was to small in order to detect a significant statistical difference (power=0.11). The same was observed when performing a power analysis for the questionnaires related to knowledge of DCC, attitude regarding AF, and self-management activities.

The number of patients who were aware of the fact that AF is a common disease was significantly higher in the education group at follow-up. When patients know that their condition is common, they might be more open to talk about it with family, physicians, or other patients who suffer from the same disease as they are. This may also enhance patient's knowledge, attitude and self-management related to their disease. On the other hand, when patient's believe that their condition is rare, they might search for more information on the internet by consulting 'Doctor Google', creating a wrong image about their condition.

✓ ***Knowledge levels before and after the educational intervention***

Patients who received oral education with the aid of information booklets regarding AF and DCC reported a mean score of 86.56% on the overall educational intervention. In addition, all patients stated that the education had enlarged their knowledge regarding AF. This was reflected in the overall knowledge score of AF, which was significantly higher after patients were provided with patient education. Other studies also showed that patient education contributes to an increased knowledge of patients regarding their disease (2, 5, 41, 43). After the educational intervention, significantly more patients had knowledge about the side effects of taking anticoagulant drugs. In addition, the number of patients knowing that anticoagulation medication is prescribed in order to prevent the risk of blood clots which can cause stroke was higher post-education (76.2% pre- vs. 90.5% post-education), but did not reach statistical significant values. However, both findings may contribute to an enhanced medication compliance and a reduced risk for stroke and/or bleedings. Although more patients reported correct responses related to which problems AF can cause if left untreated (38.1% pre- vs. 51.9% post-education), this number was still low and still too many patients believe that AF can directly cause a heart attack. The number of patients who were aware of the fact that AF is a common disease was higher after receiving education, but did not reach statistically significant values. Another positive trend was observed in the number of patients knowing different treatment modalities of AF (42.9% pre- vs. 66.7% post-education). This may

increase patient's contribution in deciding their best treatment option in confer with their physician, contributing to a shared clinical decision making model (3).

Besides a greater knowledge of AF, patients also showed a better overall contribution in self-management activities post-education. The latter was reflected in the fact that more patients reported to restrict alcohol intake and to exercise at least three times a week at follow-up. In addition, a positive trend was seen in the number of patients being aware of the fact that it is particularly risky if a person does not feel his/her AF (asymptomatic AF). This was attended with a significant increase in the number of patients who recognize the importance of monitoring their pulse regularly in order to detect asymptomatic AF episodes in an early stage (P=0.045). However, still too few patients reported to perform daily pulse self-examination (28.6% pre- vs. 38.1% post-education), which may delay detection of AF recurrence post-DCC. This low number was also demonstrated by the study of McCabe et. al, in which only 59% reported daily pulse taking, even after educational interventions (5). Instead, in this study many patients said to monitor their pulse on a regular base or to check their pulse when suspecting an irregular heart rhythm. Therefore, it is better to use a four-point Likert scale comprising items like 'never', 'seldom', 'sometimes', and 'always' to assess patients performance of self-management behavior (7). Hence, this study may underscore patient's contribution in monitoring their pulse in order to detect an irregular rhythm.

No significant difference was seen in total score related to knowledge of DCC before and after the intervention. However, the baseline score was already high (median percentage of score of 90 (IQR 10) and therefore difficult to further improve. Due to a low power, significant differences might be observed when using a larger sample size. After the education, very few patients (38.1%) were aware that the success rate of DCC is below 100%. Hence, more attention is needed to put this right in order to make a good shared clinical decision (3). The number of patients who knew that a TEE research can occur preceding the cardioversion in order to detect blood clots in the LAA was significantly increased post-intervention. This might set patient's mind at ease when undergoing a future DCC attempt if necessary. This study was the first to evaluate the knowledge of AF patients undergoing DCC with respect to the DCC procedure before and after providing patient education. The knowledge of DCC questionnaire was developed by the research team, but may have been too easy. It is therefore recommended for future studies to assess patient's knowledge of DCC by using the same or a different questionnaire in order to be able to draw better conclusions concerning this topic.

Although the overall attitude score did not improve after providing education, the number of patients reported to be afraid of the complications of AF had significantly decreased after the education. This may be attributed to the reassuring effect of the education, which focused on the fact that the AF-related complications are avoidable if patients take their medication properly and change their lifestyle with respect to their AF condition.

The usefulness of educational booklets about AF in order to improve patient's knowledge regarding their disease was previously demonstrated (41). Our study revealed that patients who stated to have read the booklets at home did not show higher knowledge scores. However, the honesty of

these patients should be taken into consideration and might be attributed to the 'white-coat effect' by interviewing the patients (47). Hence, the actual number of patients who read the booklets might have been overestimated. In future studies, the use of booklets as part of the educational intervention should be addressed by means of self-reporting instead of interviewing. Furthermore, although this study evaluated patient's perceptions regarding the information booklets in contrast with the study of Lip (41), more detailed feedback should be provided about the optimum length and comprehension in order to further improve these booklets.

- ✓ ***Knowledge levels before and after receiving usual care***

At follow-up, no significant differences were detected in the overall levels related to knowledge of AF, knowledge of DCC, and self-management behavior of patients assigned to the control group before and after receiving usual care. Patient's overall attitude towards their disease was significantly lower at follow-up. This might be attributed to the fact that patients already had undergone their DCC attempt, which was successful in most patients. Consequently these patients might not consider AF as a serious disease anymore and/or be afraid of its complications. A negative trend was observed for patient's knowledge of DCC, showing a decrease of 6%. Less patients knew whether they were able to eat or drink before undergoing DCC, probably because they did not remember and did not receive additional information regarding DCC after the cardioversion.

On the other hand, a non-significant increase was seen in the overall contribution of patients in their self-management activities. The number of patients reporting correct responses with respect to the importance of taking their medication properly had significantly increased at follow-up. In addition, less patients reported to forget to take their medication sometimes (28.6% at baseline vs. 4.8% at follow-up, P=0.025), reaching levels similar to those of the education group. Both findings might be due to the high amount of anticoagulation prescribed post-DCC. Consequently, more patients were informed by the cardiologist about the risks of TE and stroke when not taking their anticoagulant drugs properly. However, a significant decrease was observed in the number of patients finding it necessary to take anticoagulant drugs when there is no embolic complication. Taken together, more patients in the control group know that they have to take their medication properly in order to prevent severe consequences of AF (instead of preventing a heart attack), but they believe that they only need to take their anticoagulation medication when a blood clot is present. Hence, these patients might think anticoagulation therapy is a 'cure' for blood clots instead of a prevention.

Although patient's overall attitude had not change at follow-up compared to baseline, significantly less patients completely agreed to find it important to monitor their pulse regularly in order to detect asymptomatic AF episodes in an early stage. This might also be because patients already had undergone their DCC attempt and might not know that monitoring their pulse is important to detect a possible relapse of AF.

✓ ***Correlations between patient characteristics and knowledge levels***

Patients with higher education levels scored significantly higher on the knowledge of AF and the knowledge of DCC questionnaires. This was also reported by other studies (5, 7) and relates to a better ability in acquiring and understanding knowledge. Hence, healthcare providers should more focus on improving the knowledge regarding AF in poorly educated patients. Furthermore, no significant differences were found in the knowledge levels, attitudes or self-management activities between newly diagnosed patients and patients who had already received previous treatment attempts. Hence, even though the latter group have had more educational opportunities during previous consulting hours, patient education should still be repeated in order to reinforce and supplement patient's knowledge of AF (7). Furthermore, a trend towards lower AF and DCC knowledge scores was found in those patients having a longer follow-up duration, however this was not statistically significant. This effect was also observed by other studies (5). For example, Thomson et al. showed that in spite of improvements in knowledge levels after the educational intervention, these levels were not definite and had returned to pre-education levels after three months of follow-up (48). It is important to keep in mind that patient education is not a one-time thing.

Patients who admitted to have forgotten to take their medication once and/or several times during the follow-up period was not significant different between groups. However, these patients showed lower scores on the self-management questionnaire (R^2=0.354). If this non-adherence to a therapeutic regimen is intentional, the educational intervention should focus on changing patients personal motivations about their medication. Since patients might have concerns about the necessity, addictive, and toxic effects of the medication (2), a CNS may provide individualized education in laymen terms in order to change patients perceptions (8, 22). When this medical non-adherence is unintentional but patients have problems with remembering to take their medication, a digital coach associated with telemonitoring may come to the rescue.

4.5 Study limitations

The sample size of the study population was relatively small. In addition, the study was conducted in one hospital and therefore monocentric. Some patients were evaluated by self-reporting, others by interviewing. This may have led to an over- or underestimation of the scores and should be taken into account when interpreting the results. Furthermore, the study did not took dementia or other cognitive problems into account which may have influenced the effect of the education.

Conclusions

DCC was successful in 90% of the patients and only 27.8% relapsed into AF at four weeks post-DCC. The prescription of anticoagulation therapy in AF patients post-DCC was in accordance with the 2014 AHA/ACC/HRS guidelines. However, more research is needed to evaluate the predictive value of antiarrhythmic drugs in the setting of electrical cardioversion. Due to its contradictory results, the SF-36 questionnaire was not considered a useful tool for determining changes in symptoms and health status related to AF of patients undergoing DCC.

Patient's baseline knowledge levels were low regarding problems of untreated AF (i.e. stroke and TICM) and side effects of taking anticoagulant drugs. This puts the patient at risk for hemorrhage and increases their predisposition for TE. In addition, only a few patients knew different treatment modalities of AF and/or knew the exact efficiency rate of DCC. Both findings reduce patient's contribution in shared clinical decision making, which has been shown to be important regarding patient's outcome and quality of life. Furthermore, only 28.6% of the total study population reported to perform daily pulse self-examination at baseline. These knowledge deficits may be attributed to the lack of information and explanations given by physicians due to time constraints and lack of appropriate educational tools.

By providing education including information booklets about AF and DCC to AF patients undergoing DCC, we showed that their knowledge of AF as well as their contribution in self-management activities were enhanced. Patients reported less alcohol usage, more physical exercise according to their AF condition, and recognized the importance of monitoring their pulse regularly in order to detect asymptomatic AF episodes in an early stage. In addition, patient's knowledge concerning anticoagulation therapy was improved, with more patients knowing the reason for taking their medication and being aware of its side effects. A positive trend was observed in the number of patients having knowledge regarding the different treatment modalities of AF, which may enhance patients understanding regarding their personal risks and increases their contribution in shared clinical decision making. Taken together, patient education has a positive reassuring effect on patient's attitude and may increase patients knowledge of AF, thereby improving patient's adherence to a prescribed medical and/or lifestyle regimen and activate patients in their self-management roles.

Although patients were given both verbal and written information regarding the symptoms, risk factors, complications of untreated AF, treatment modalities, recommended self-management behaviors, etc., their knowledge level still was less than desired on a number of items. More than half of the patients still believe that AF can directly cause a heart attack or sudden death. Hence, patients need to be reminded that AF itself is not a life-threatening disease and that the risk of complications can be reduced if they take their medication properly and/or change their lifestyle. Since smoking is a risk factor for developing AF, more educational intervention should be provided to smokers about the impact of smoking on AF in order to change their perceptions and attitude towards their disease. Furthermore, only 38.1% of patients reported to perform daily pulse self-examination, which may delay the detection of AF recurrence post-DCC.

Despite that educated patients showed better knowledge regarding their disease, AF recurrence was not detected faster in these patients compared to patients who received usual care. Future studies might therefore provide an educational intervention plus a pulse self-monitoring protocol in order to detect AF recurrence post-DCC in an early stage. In addition, more feedback is needed about the content of the information booklets as part of the educational intervention, e.g. What kind of information was superfluous or lacking? Further research should take the presence of dementia in AF patients into account in order to determine how well patients with AF retain and apply the education that was provided. Additionally, the knowledge of DCC questionnaire should be further evaluated in a setting comprising more patients.

It is important to keep in mind that educational interventions need to be repeated after a period of time in order to reinforce and supplement patient's knowledge of their disease. Nonetheless, patients should be able to ask questions, explanations or clarification of any concerns. Due to the limited consultation time, a CNS might provide personalized patient education and assess patient's educational needs as part of an AF clinic.

References

1. Holdright DDR. Cardiac Conditions - Atrial Fibrillation. 2010.
2. Clarkesmith DE, Pattison HM, Lane DA. Educational and behavioural interventions for anticoagulant therapy in patients with atrial fibrillation. The Cochrane database of systematic reviews. 2013;6:CD008600. PubMed PMID: 23736948.
3. Seaburg L, Hess EP, Coylewright M, Ting HH, McLeod CJ, Montori VM. Shared decision making in atrial fibrillation: where we are and where we should be going. Circulation. 2014 Feb 11;129(6):704-10. PubMed PMID: 24515956.
4. Vizzardi E, Curnis A, Latini MG, Salghetti F, Rocco E, Lupi L, et al. Risk factors for atrial fibrillation recurrence: a literature review. Journal of cardiovascular medicine. 2014 Mar;15(3):235-53. PubMed PMID: 23114271.
5. McCabe PJ, Schad S, Hampton A, Holland DE. Knowledge and self-management behaviors of patients with recently detected atrial fibrillation. Heart & lung : the journal of critical care. 2008 Mar-Apr;37(2):79-90. PubMed PMID: 18371501.
6. Seeck A, Rademacher W, Fischer C, Haueisen J, Surber R, Voss A. Prediction of atrial fibrillation recurrence after cardioversion-interaction analysis of cardiac autonomic regulation. Medical engineering & physics. 2013 Mar;35(3):376-82. PubMed PMID: 22763022.
7. Xu W, Sun G, Lin Z, Chen M, Yang B, Chen H, et al. Knowledge, attitude, and behavior in patients with atrial fibrillation undergoing radiofrequency catheter ablation. Journal of interventional cardiac electrophysiology : an international journal of arrhythmias and pacing. 2010 Sep;28(3):199-207. PubMed PMID: 20556497. Pubmed Central PMCID: 2947015.
8. Hendriks JM, de Wit R, Crijns HJ, Vrijhoef HJ, Prins MH, Pisters R, et al. Nurse-led care vs. usual care for patients with atrial fibrillation: results of a randomized trial of integrated chronic care vs. routine clinical care in ambulatory patients with atrial fibrillation. European heart journal. 2012 Nov;33(21):2692-9. PubMed PMID: 22453654.
9. Gutierrez C, Blanchard DG. Atrial fibrillation: diagnosis and treatment. American family physician. 2011 Jan 1;83(1):61-8. PubMed PMID: 21888129.
10. Lane DA, Lip GY. Use of the CHA(2)DS(2)-VASc and HAS-BLED scores to aid decision making for thromboprophylaxis in nonvalvular atrial fibrillation. Circulation. 2012 Aug 14;126(7):860-5. PubMed PMID: 22891166.
11. Prystowsky EN PB, Waldo AL. . Chapter 40. Atrial Fibrillation, Atrial Flutter, and Atrial Tachycardia. New York, NY: McGraw-Hill2011. Available from: http://accessmedicine.mhmedical.com/content.aspx?bookid=376&Sectionid=40279769.
12. Iwasaki YK, Nishida K, Kato T, Nattel S. Atrial fibrillation pathophysiology: implications for management. Circulation. 2011 Nov 15;124(20):2264-74. PubMed PMID: 22083148.
13. Center CPM. Atrial Fibrillation - Information, Symptoms, Treatment Options2014. Available from: http://www.cpmc.org/services/heart/conditions/heartrhythm.html.
14. Cantillon DJ. Atrial Fibrillation 2014. Available from: http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/cardiology/atrial-fibrillation/Default.htm.
15. Steger C, Pratter A, Martinek-Bregel M, Avanzini M, Valentin A, Slany J, et al. Stroke patients with atrial fibrillation have a worse prognosis than patients without: data from the Austrian Stroke registry. European heart journal. 2004 Oct;25(19):1734-40. PubMed PMID: 15451152.
16. Scientific B. Left Atrial Appendage. 2015.
17. National Heart L, and Blood Institute Atrial Fibrillation and Stroke 2014.
18. Zimmermann AJ, Bossard M, Aeschbacher S, Schoen T, Voellmin G, Suter Y, et al. Effects of sinus rhythm maintenance on left heart function after electrical cardioversion of atrial fibrillation: implications for tachycardia-induced cardiomyopathy. The Canadian journal of cardiology. 2015 Jan;31(1):36-43. PubMed PMID: 25547548.
19. Umana E, Solares CA, Alpert MA. Tachycardia-induced cardiomyopathy. The American journal of medicine. 2003 Jan;114(1):51-5. PubMed PMID: 12543289.
20. Gupta S, Figueredo VM. Tachycardia mediated cardiomyopathy: pathophysiology, mechanisms, clinical features and management. International journal of cardiology. 2014 Mar 1;172(1):40-6. PubMed PMID: 24447747.
21. January CT, Wann LS, Alpert JS, Calkins H, Cigarroa JE, Cleveland JC, Jr., et al. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. Journal of the American College of Cardiology. 2014 Dec 2;64(21):e1-76. PubMed PMID: 24685669.

22. Berti D, Hendriks JM, Brandes A, Deaton C, Crijns HJ, Camm AJ, et al. A proposal for interdisciplinary, nurse-coordinated atrial fibrillation expert programmes as a way to structure daily practice. European heart journal. 2013 Sep;34(35):2725-30. PubMed PMID: 23520187.
23. Jabaudon D, Sztajzel J, Sievert K, Landis T, Sztajzel R. Usefulness of ambulatory 7-day ECG monitoring for the detection of atrial fibrillation and flutter after acute stroke and transient ischemic attack. Stroke; a journal of cerebral circulation. 2004 Jul;35(7):1647-51. PubMed PMID: 15155965.
24. Smit MD, Crijns HJ, Tijssen JG, Hillege HL, Alings M, Tuininga YS, et al. Effect of lenient versus strict rate control on cardiac remodeling in patients with atrial fibrillation data of the RACE II (RAte Control Efficacy in permanent atrial fibrillation II) study. Journal of the American College of Cardiology. 2011 Aug 23;58(9):942-9. PubMed PMID: 21851883.
25. Tieleman RG, Van Gelder IC, Crijns HJ, De Kam PJ, Van Den Berg MP, Haaksma J, et al. Early recurrences of atrial fibrillation after electrical cardioversion: a result of fibrillation-induced electrical remodeling of the atria? Journal of the American College of Cardiology. 1998 Jan;31(1):167-73. PubMed PMID: 9426036.
26. Pantridge JF, Halmos PB. Conversion of Atrial Fibrillation by Direct Current Counter Shock. British heart journal. 1965 Jan;27:128-31. PubMed PMID: 14242153. Pubmed Central PMCID: 490143.
27. McDonald L, Resnekov L, O'Brien K. Direct-Current Shock in Treatment of Drug-Resistant Cardiac Arrhythmias. British medical journal. 1964 Jun 6;1(5396):1468-70. PubMed PMID: 14132081. Pubmed Central PMCID: 1814665.
28. Lown B, Perlroth MG, Kaidbey S, Abe T, Harken DE. "Cardioversion" of atrial fibrillation. A report on the treatment of 65 episodes in 50 patients. The New England journal of medicine. 1963 Aug 15;269:325-31. PubMed PMID: 13931297.
29. Simonian SM, Lotfipour S, Wall C, Langdorf MI. Challenging the superiority of amiodarone for rate control in Wolff-Parkinson-White and atrial fibrillation. Internal and emergency medicine. 2010 Oct;5(5):421-6. PubMed PMID: 20437113.
30. Frick M, Frykman V, Jensen-Urstad M, Ostergren J, Rosenqvist M. Factors predicting success rate and recurrence of atrial fibrillation after first electrical cardioversion in patients with persistent atrial fibrillation. Clinical cardiology. 2001 Mar;24(3):238-44. PubMed PMID: 11288971.
31. Thomas SP, Sanders P. Catheter ablation for atrial fibrillation. Heart, lung & circulation. 2012 Jun;21(6-7):395-401. PubMed PMID: 22575531.
32. Wharton JM. Catheter ablation for atrial fibrillation: should it be first-line therapy? American heart journal. 2007 Apr;153(4 Suppl):74-80. PubMed PMID: 17394906.
33. Doshi RN, Daoud EG, Fellows C, Turk K, Duran A, Hamdan MH, et al. Left ventricular-based cardiac stimulation post AV nodal ablation evaluation (the PAVE study). Journal of cardiovascular electrophysiology. 2005 Nov;16(11):1160-5. PubMed PMID: 16302897.
34. Lehto M, Kala R. Persistent atrial fibrillation: a population based study of patients with their first cardioversion. International journal of cardiology. 2003 Dec;92(2-3):145-50. PubMed PMID: 14659845.
35. Blich M, Edoute Y. Electrical cardioversion for persistent or chronic atrial fibrillation: outcome and clinical factors predicting short and long term success rate. International journal of cardiology. 2006 Mar 8;107(3):389-94. PubMed PMID: 16503261.
36. Bertaglia E, Zoppo F, Bonanno C, Pellizzari N, Frigato N, Pascotto P. Autonomic modulation of the sinus node following electrical cardioversion of persistent atrial fibrillation: relation with early recurrence. International journal of cardiology. 2005 Jul 10;102(2):219-23. PubMed PMID: 15982488.
37. Climent V, Marin F, Monmeneu JV, Garcia de Burgos F, Sogorb F. Atrial stunning as predictor of early relapse into atrial fibrillation after cardioversion. International journal of cardiology. 2006 Jun 28;110(3):427-8. PubMed PMID: 16378649.
38. Rademacher W, Seeck A, Surber R, Lauten A, Prochnau D, Voss A, et al. Multidimensional ECG-based analysis of cardiac autonomic regulation predicts early AF recurrence after electrical cardioversion. Journal of electrocardiology. 2012 Mar;45(2):116-22. PubMed PMID: 22030288.
39. Allessie M, Ausma J, Schotten U. Electrical, contractile and structural remodeling during atrial fibrillation. Cardiovascular research. 2002 May;54(2):230-46. PubMed PMID: 12062329.
40. Wijffels MC, Kirchhof CJ, Dorland R, Allessie MA. Atrial fibrillation begets atrial fibrillation. A study in awake chronically instrumented goats. Circulation. 1995 Oct 1;92(7):1954-68. PubMed PMID: 7671380.
41. Lane DA, Ponsford J, Shelley A, Sirpal A, Lip GY. Patient knowledge and perceptions of atrial fibrillation and anticoagulant therapy: effects of an educational intervention programme. The West Birmingham Atrial Fibrillation Project. International journal of cardiology. 2006 Jun 28;110(3):354-8. PubMed PMID: 16253356.
42. Aliot E, Breithardt G, Brugada J, Camm J, Lip GY, Vardas PE, et al. An international survey of physician and patient understanding, perception, and attitudes to atrial fibrillation and its

contribution to cardiovascular disease morbidity and mortality. Europace : European pacing, arrhythmias, and cardiac electrophysiology : journal of the working groups on cardiac pacing, arrhythmias, and cardiac cellular electrophysiology of the European Society of Cardiology. 2010 May;12(5):626-33. PubMed PMID: 20421224. Pubmed Central PMCID: 2859877.
43. Hendriks JM, Crijns HJ, Tieleman RG, Vrijhoef HJ. The atrial fibrillation knowledge scale: development, validation and results. International journal of cardiology. 2013 Sep 30;168(2):1422-8. PubMed PMID: 23305860.
44. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. Journal of clinical hypertension. 2008 May;10(5):348-54. PubMed PMID: 18453793. Pubmed Central PMCID: 2562622.
45. Health R. 36-Item Short Form Survey from the RAND Medical Outcomes Study2009. Available from: http://www.rand.org/health/surveys_tools/mos/mos_core_36item.html.
46. Lafuente-Lafuente C, Mouly S, Longas-Tejero MA, Mahe I, Bergmann JF. Antiarrhythmic drugs for maintaining sinus rhythm after cardioversion of atrial fibrillation: a systematic review of randomized controlled trials. Archives of internal medicine. 2006 Apr 10;166(7):719-28. PubMed PMID: 16606807.
47. Cobos B, Haskard-Zolnierek K, Howard K. White coat hypertension: improving the patient-health care practitioner relationship. Psychology research and behavior management. 2015;8:133-41. PubMed PMID: 25999772. Pubmed Central PMCID: 4427265.
48. Thomson RG, Eccles MP, Steen IN, Greenaway J, Stobbart L, Murtagh MJ, et al. A patient decision aid to support shared decision-making on anti-thrombotic treatment of patients with atrial fibrillation: randomised controlled trial. Quality & safety in health care. 2007 Jun;16(3):216-23. PubMed PMID: 17545350. Pubmed Central PMCID: 2464985.

Appendix

Questionnaires

I. ALGEMEEN – I

Instructies: Duid voor elke vraag het juiste antwoord aan. Er is telkens maar één juist antwoord mogelijk.

1. **Wat is voorkamerfibrillatie?**
    a. Een hartziekte waarbij het hart niet in staat is om voldoende bloed doorheen het lichaam te pompen.
    b. Een stoornis in het bloed waardoor bloedklonters in het hart ontstaan.
    c. Een ritmestoornis van het hart waarbij het hart onregelmatig en meestal sneller dan normaal klopt.
2. **Voorkamerfibrillatie komt zelden voor.**
    a. Waar
    b. Niet waar
    c. Ik weet het niet
3. **Wat zijn de symptomen/klachten van voorkamerfibrillatie?**
    a. Hartkloppingen, pijn of druk op de borst, vermoeidheid, kortademigheid
    b. Koorts, hoofdpijn, bleek zijn
    c. Overgeven en diarree, constipatie, maagpijn
4. **Welke van onderstaande factoren kunnen voorkamerfibrillatie uitlokken?**
    a. Allergie voor gras, dieren of huisstof
    b. Alcohol, cafeïne, stress, hoge bloeddruk, zwaarlijvigheid
    c. Lawaai of harde geluiden
5. **Het is vooral een risico wanneer de patiënt zijn/haar voorkamerfibrillatie niet voelt (zonder symptomen).**
    a. Waar
    b. Niet waar
    c. Ik weet het niet
6. **Welke van onderstaande stellingen is juist omtrent de fysieke inspanning van patiënten met voorkamerfibrillatie?**
    a. Het is belangrijk dat deze patiënten rusten, voor het behoud van een normale hartactiviteit.
    b. Patiënten met chronische voorkamerfibrillatie kunnen niet fulltime werken.
    c. Het is belangrijk om normaal te sporten binnen de persoonlijke beperkingen, doch is intensief duursporten (fietsen, lopen gewichtheffen, roeien) niet aangeraden.
7. **Welke van de onderstaande stellingen is juist?**
    a. Voorkamerfibrillatie is levensbedreigend, aangezien het kan resulteren in een hartaanval.
    b. Voorkamerfibrillatie is volkomen onschadelijk.
    c. Leven met voorkamerfibrillatie is mogelijk, indien de juiste medicatie wordt genomen.
8. **Waarom is het belangrijk om mijn medicatie voor voorkamerfibrillatie correct te nemen?**
    a. Omdat de dokter wil dat ik dit doe.
    b. Om ernstige gevolgen van de ritmestoornis te voorkomen.
    c. Om de mogelijkheid van een hartaanval of plotse dood te voorkomen.
9. **Waarom wordt voor sommige patiënten met voorkamerfibrillatie antistollingsmedicatie (zoals Marcoumar, Pradaxa, Eliquis, Claxane, Xarelto,…) voorgeschreven?**
    a. Om te voorkomen dat bloedklonters ontstaan die een beroerte of herseninfarct kunnen veroorzaken.
    b. Om ervoor te zorgen dat het bloed gemakkelijker in de bloedvaten en doorheen het lichaam stroomt.
    c. Om te voorkomen dat vloeistof zich opstapelt in het lichaam.
10. **Waarom moet iemand die antistollingsmedicatie neemt voorzichtig zijn met het gebruik van alcohol?**
    a. Alcohol verhoogt de opstapeling van vocht in het lichaam, waardoor het bloed te dun wordt.
    b. Alcohol veroorzaakt een verstopping van de bloedvaten, waardoor het bloed langzamer terug naar het hart stroomt.
    c. Alcohol heeft een invloed op het effect van de medicatie, en dit heeft op zijn beurt een invloed op de mogelijkheid om bloedklonters te vormen.

II. ALGEMEEN – II

<u>Instructies:</u> Beantwoord elke vraag met 'ja' of 'neen'. Er is steeds maar één antwoord mogelijk.

		JA	NEEN
11.	Weet u welke gevolgen voorkamerfibrillatie kan veroorzaken?		
12.	Kent u mogelijke behandelingsopties van voorkamerfibrillatie en hun doel?		
13.	Weet u of er bijwerkingen zijn die gepaard gaan met het nemen van antistollingsmedicatie (bloedverdunnende medicatie)? Zo ja, welke?		
14.	Kent u de impact van roken op voorkamerfibrillatie?		

III. ELEKTRISCHE CARDIOVERSIE

<u>Instructies:</u> Beantwoord elke vraag met 'waar' of 'niet waar'. Er is steeds maar één antwoord mogelijk.

		WAAR	NIET WAAR
1.	De behandeling kan een doeltreffendheid van 100% bereiken.		
2.	In normale omstandigheden mag de patiënt na de cardioversie naar huis, en hoeft hij/zij niet in het ziekenhuis te blijven.		
3.	De eerste 24u na cardioversie mag de patiënt zelf met een voertuig rijden.		
4.	Er bestaat een grote kans dat de hartritmestoornis vroeg of laat weer optreedt.		
5.	Er zijn geen ernstige complicaties die gepaard gaan met cardioversie, indien de patiënt 4 à 6 weken voor de ingreep bloedverdunners of antistollingsmedicatie neemt (indien voorgeschreven door de arts).		
6.	Voor cardioversie hoeft de patiënt niet nuchter te zijn.		
7.	Tijdens elektrische cardioversie wordt een elektrische shock aan de hartspier gegeven, met als doel de hartritmestoornis te beëindigen.		
8.	Na elektrische cardioversie hoeft de patiënt geen medicatie meer te nemen.		
9.	Voor de elektrische cardioversie is het mogelijk dat een TEE-onderzoek (echografie van het hart via de slokdarm) plaatsvindt om bloedklonters aanwezig in het hart op te sporen.		
10.	Voor deze ingreep wordt de patiënt in slaap gedaan.		

IV. ATTITUDE OMTRENT VOORKAMERFIBRILLATIE

<u>Instructies:</u> Duid voor onderstaande stellingen het antwoord aan dat het beste aansluit met uw mening, gaande van 'helemaal mee eens' tot 'helemaal mee oneens'. Er is steeds maar één antwoord mogelijk.

	Helemaal mee eens	Mee eens	Neutraal	Oneens	Helemaal oneens
1. Ik vind dat voorkamerfibrillatie een ernstige ziekte is.					
2. Indien voorkamerfibrillatie niet behandeld wordt, denk ik dat deze aandoening een invloed heeft op mijn levenskwaliteit.					
3. Ik ben bang voor de complicaties van voorkamerfibrillatie.					
4. Het goed naleven van de voorgeschreven medicatie/levensstijl kan oncomfortabele symptomen, veroorzaakt door de voorkamerfibrillatie, verminderen.					
5. Wanneer er geen sprake is van een bloedklonter als complicatie, is het niet nodig om antistollingsmedicatie (bloedverdunners) te nemen.					
6. Op controleraadpleging komen is tijdverspilling.					
7. Ik vertrouw meer op de begeleiding van het medisch personeel, dan de informatie die ik kan verkrijgen via de krant, televisie of andere media over voorkamerfibrillatie.					
8. Ik moet regelmatig mijn polsslag controleren om asymptomatische aanvallen van voorkamerfibrillatie (zonder symptomen of klachten) en gezondheidsproblemen in een vroeg stadium op te sporen.					

V. NALEVEN VOORGESCHREVEN MEDICATIE EN/OF LEVENSSTIJL

<u>Instructies:</u> Beantwoord elke vraag met 'ja' of 'neen'. Er is steeds maar één antwoord mogelijk.

		JA	NEEN
1.	Vergeet u soms uw medicatie te nemen?		
2.	Heeft u ooit de dosis van uw medicatie verlaagd of bent u er ooit mee gestopt omdat u zich slechter voelde door de medicatie, zonder dit aan uw arts te melden?		
3.	Wanneer u op vakantie gaat of het huis verlaat, vergeet u dan soms om uw medicatie mee te nemen?		
4.	Wanneer u merkt dat uw klachten (symptomen) onder controle zijn of verdwenen zijn, stopt u dan soms met het nemen van uw medicatie zonder dit aan uw arts te melden?		
5.	Is het dagelijks nemen van medicatie voor u een ongemak?		
6.	Beperkt u het gebruik van alcohol inname?		
7.	Indien u rookt: stopt u of beperkt u het roken omwille van uw voorkamerfibrillatie?		
8.	Streeft u naar gewichtsverlies naar aanleiding van uw voorkamerfibrillatie?		
9.	Controleert u dagelijks uw pols?		
10.	Doet u dagelijks of minstens 3x/week aan fysieke activiteit, zoals wandelen?		

VI. EVALUATIE	
1.	**Wat vond u over het algemeen van de educatie?** 0 Uitstekend 0 Zeer goed 0 Goed 0 Matig 0 Slecht
2.	**Wat vond u van de brochure omtrent elektrische cardioversie?** 0 Uitstekend 0 Zeer goed 0 Goed 0 Matig 0 Slecht
3.	**Wat vond u van de brochure omtrent voorkamerfibrillatie en –flutter?** 0 Uitstekend 0 Zeer goed 0 Goed 0 Matig 0 Slecht
4	**Was de uitleg die u kreeg duidelijk?** 0 Ja 0 Neen
5.	**Heeft de educatie bijgedragen aan het verhogen van uw kennis omtrent uw ziekte?** 0 Ja 0 Neen

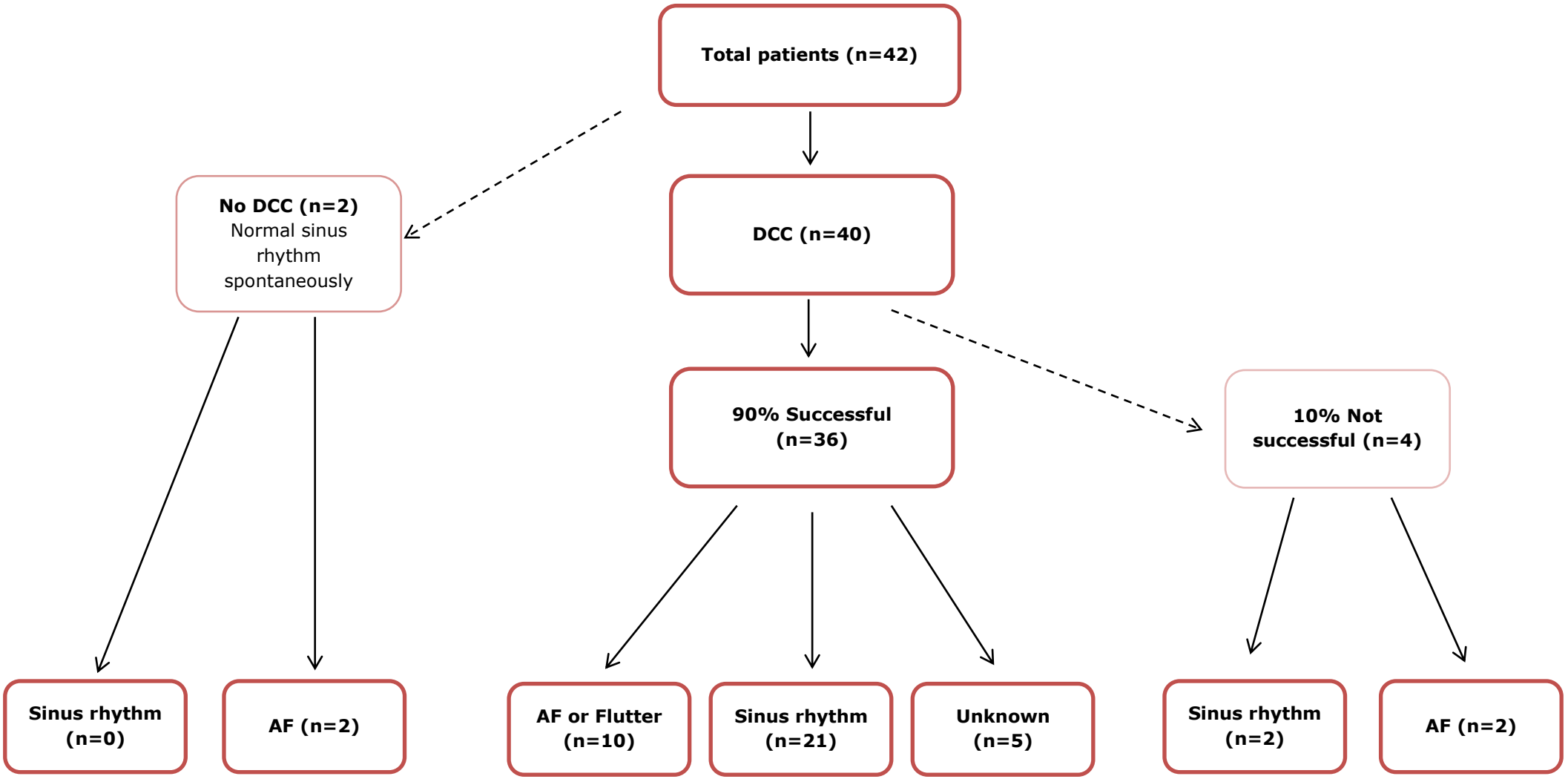

Figure 12: Flowchart of the immediate and long-term success rate of patients undergoing DCC**.** n: sample size. *DCC* direct-current cardioversion; *AF* atrial fibrillation

Table 11: Quality of life at follow-up of patients who underwent DCC, either successful (n=36) or unsuccessful DCC (n=4).

Item	Successful DCC (n=36)		Unsuccessful DCC (n=4)		P-value
	Percentage of score	Highest percentage of score (lowest percentage of score)	Percentage of score	Highest percentage of score (lowest percentage of score)	
PF	70 (30)	100 (15)	47.50 (IQR 33.75)	80 (40)	0.155
SF	95 (22)	100 (44)	100 (50.25)	100 (33)	0.659
RP	100 (75)	100 (0)	37.50 (81.25)	100 (0)	0.177
RE	100 (0)	100 (0)	100 (50.25)	100 (33)	0.731
MH	73.68 ± 14.92	100 (28)	58 ± 24.98	92 (32)	0.300
VT	69.58 ± 19.62	100 (25)	53.75 ± 31.19	95 (20)	0.388
BP	100 (15)	100 (22)	100 (15.75)	100 (79)	0.664
GH	65 (25)	95 (25)	52.50 (60)	75 (10)	0.354
CH	50 (25)	100 (25)	62.50 (25)	75 (50)	0.587

Data are presented as mean ± standard deviation for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. n: sample size. A P-value <0.05 was considered a statistically significant difference. *PF* physical functioning; *SF* social functioning; *RP* role limitations due to physical health problems; *RE* role limitations due to emotional problems; *MH* mental health; *VT* vitality; *BP* bodily pain; *GH* general health perceptions; *CH* change in health.

Table 12: Quality of life of patients who were either in sinus rhythm (n=23) or in AF (n=14) at follow-up.

Item	AF present at FU (n=14)		Sinus rhythm at FU (n=23)		P-value
	Percentage of score	Highest percentage of score (lowest percentage of score)	Percentage of score	Highest percentage of score (lowest percentage of score)	
PF	61.79 ± 19.96	100 (30)	69.09 ± 22.82	100 (15)	0.322
SF	94.50 (IQR 24.75)	100 (44)	100 (IQR 13.75)	100 (33)	0.608
RP	100 (IQR 56.25)	100 (0)	75 (IQR 75)	100 (0)	0.332
RE	100 (IQR 33)	100 (0)	100 (IQR 0)	100 (0)	0.271
MH	78 (IQR 26)	92 (28)	75.50 (IQR 25.50)	100 (32)	0.742
VT	77.50 (IQR 38.75)	95 (20)	65 (IQR 30)	100 (20)	0.353
BP	100 (IQR 16.50)	100 (22)	100 (IQR 21)	100 (35)	0.898
GH	67.50 (IQR 21.25)	85 (10)	65 (IQR 35)	95 (25)	0.975
CH	50 (IQR 25)	100 (25)	50 (IQR 25)	75 (25)	0.894

Data are presented as mean ± standard deviation for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. n: sample size. A P-value <0.05 was considered a statistically significant difference. *AF* atrial fibrillation; *FU* follow-up; *PF* physical functioning; *SF* social functioning; *RP* role limitations due to physical health problems; *RE* role limitations due to emotional problems; *MH* mental health; *VT* vitality; *BP* bodily pain; *GH* general health perceptions; *CH* change in health.

Table 13: Comparison of quality of life of all 42 AF patients at baseline and at follow-up.

Item	BASELINE (n=42)		FOLLOW-UP (n=42)		P-value
	Percentage of score	Highest percentage of score (lowest percentage of score)	Percentage of score	Highest percentage of score (lowest percentage of score)	
PF	63.57 ± 22.93	100 (20)	65.95 ± 21.22	100 (15)	0.465
SF	100 (IQR 33)	100 (0)	100 (IQR 22)	100 (33)	0.743
RP	50 (IQR 81.25)	100 (0)	87.50 (IQR 75)	100 (0)	0.052
RE	100 (IQR 67)	100 (0)	100 (IQR 0)	100 (0)	0.159
MH	75.33 ± 16.67	100 (24)	71.90 ± 16.55	100 (28)	0.208
VT	62.86 ± 23.71	100 (5)	67.00 ± 22.26	100 (20)	0.276
BP	100 (IQR 22.63)	100 (22)	100 (IQR 21)	100 (22)	0.449
GH	62.74 ± 15.90	95 (25)	62.02 ± 19.41	95 (10)	0.792
CH	50 (IQR 25)	100 (0)	50 (IQR 25)	100 (25)	0.099

Data are presented as mean ± standard deviation for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. n: sample size. A P-value <0.05 was considered a statistically significant difference. *PF* physical functioning; *SF* social functioning; *RP* role limitations due to physical health problems; *RE* role limitations due to emotional problems; *MH* mental health; *VT* vitality; *BP* bodily pain; *GH* general health perceptions; *CH* change in health.

Table 14: Comparison of medication between patients who were in sinus rhythm or in AF at follow-up.

Type of medication – n (%)	AF present at FU (n=14)	Sinus rhythm at FU (n=23)	Follow-up medication (n=42)	P-value
Anti-aggregation therapy	4 (28.6)	3 (13)	7 (16.7)	0.390
Anticoagulation therapy	14 (100)	19 (82.6)	38 (90.5)	0.276
LMWH	1 (7.1)	0 (0.0)	2 (4.8)	0.378
NOAC	11 (78.6)	13 (56.5)	27 (64.3)	0.288
Coumarin	2 (14.3)	6 (26.1)	9 (21.4)	0.683
Rate control				
β-blockers	9 (64.3)	13 (59.1)	26 (61.9)	0.641
CAA: Non-dihydropiridines	1 (7.1)	4 (17.4)	7 (16.7)	0.630
Digitalis	0 (0.0)	0 (0.0)	0 (0.0)	/
Antihypertensive drugs				
CAA: dihydropiridines	4 (28.6)	3 (13.0)	8 (19.0)	0.390
ACE-I	5 (35.7)	8 (34.8)	16 (38.1)	1
ARB	3 (21.4)	2 (8.7)	6 (14.3)	0.346
Diuretics	6 (42.9)	6 (26.1)	16 (38.1)	0.470
Antiarrhythmic drugs	6 (42.9)	13 (56.5)	23 (54.8)	0.420
Amiodaron	3 (21.4)	8 (34.8)	13 (31.0)	0.477
Flecainide	3 (21.4)	5 (21.7)	10 (23.8)	1
Statins	8 (57.1)	8 (34.8)	17 (40.5)	0.183

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation; *FU* follow-up; *LMWH* low-molecular weight heparin; *NOAC* novel oral anticoagulants for atrial fibrillation; *CAA* calcium antagonist; *ACE-I* angiotensin-converting-enzyme inhibitor; *ARB* angiotensin II receptor blockers.

Table 15: Patient's overall baseline levels regarding knowledge of AF, knowledge of DCC, attitude concerning AF, and self-management activities.

Questionnaire	Max possible score	EDUCATION (n=21)			USUAL CARE (n=21)			P-value
		Score	Highest score (lowest score)	Percentage of score (IQR)	Score*	Highest score (lowest score)	Percentage of score (IQR)	
Knowledge of AF	13	9.00 (IQR 1.50)	13 (2)	69.23 (IQR 11.53)	9.00 (IQR 3.50)	13 (4)	69.23 (IQR 26.92)	0.701
Knowledge of DCC	10	9.00 (IQR 1.00)	10 (5)	90.00 (IQR 10)	8.00 (IQR 1.50)	10 (6)	80.00 (IQR 15.00)	0.554
Attitude regarding AF	40	32.00 (IQR 4.00)	38 (27)	80.00 (IQR 10)	35.00 (IQR 3.50)	37 (29)	87.50 (IQR 8.75)	0.168
Self-management	9	7.00 (IQR 2.00)	9 (2)	77.78 (IQR 22.22)	7.00 (IQR 2.00)	9 (4)	77.78 (IQR 22.22)	0.746

Data are presented as median and interquartile range (IQR). n: sample size. A P-value <0.05 was considered a statistically significant difference. *AF* atrial fibrillation; *DCC* direct-current cardioversion.

Table 16: Patient's levels regarding knowledge of AF, knowledge of DCC, attitude concerning AF, and self-management activities at follow-up.

Questionnaire	Max possible score	EDUCATION (n=21)			USUAL CARE (n=21)			P-value
		Score	Highest score (lowest score)	Percentage of score	Score	Highest score (lowest score)	Percentage of score	
Knowledge of AF	13	10.52 ± 2.09	13 (6)	80.95 ± 16.07	9.29 ± 2.31	13 (5)	71.43 ± 17.73	0.076
Knowledge of DCC	10	9.00 (IQR 2.00)	10 (4)	90.00 (IQR 20.00)	8.00 (IQR 3.50)	10 (3)	80.00 (IQR 35.00)	0.259
Attitude regarding AF	40	32.48 ± 3.74	38 (26)	81.19 ± 9.34	32.33 ± 2.90	40 (27)	80.83 ± 7.26	0.891
Self-management	9	8.00 (IQR 1.50)	9 (3)	88.89 (IQR 16.66)	8.00 (IQR 1.00)	9 (4)	88.89 (IQR 11.11)	0.201

Data are presented as mean ± standard deviation for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. n: sample size. A P-value <0.05 was considered a statistically significant difference. *SD* standard deviation; *AF*; atrial fibrillation; *DCC* direct-current cardioversion.

Table 17: Number and percentage of correct responses related to knowledge of AF, knowledge of DCC, and self-management activities at follow-up.

Questionnaire	EDUCATION (n=21)	USUAL CARE (n=21)	P-value
	Correct response (%)	Correct response (%)	
Knowledge of AF			
Q1: What is AF	21 (100)	18 (85.7)	0.232
Q2: AF is rare condition	19 (90.5)	9 (42.9)	**0.001***
Q3: What are the symptoms of AF	20 (95.2)	20 (95.2)	1
Q4: What are the trigger factors for AF	19 (90.5)	18 (85.7)	1
Q5: It is particularly risky if a person does not feel his/her AF	17 (81.0)	15 (71.4)	0.469
Q6: Statements regarding physical exercise of patients with AF	19 (90.5)	16 (76.2)	0.410
Q7: Statements regarding to the level of danger associated with AF	18 (85.7)	17 (81.0)	1
Q8: Why is it important to take my medication for AF properly	15 (71.4)	15 (71.4)	1
Q9: Why is anticoagulation medication prescribed in certain AF patients	19 (90.5)	19 (90.5)	1
Q10: Why should a person using anticoagulation medication be careful with the use of alcohol	14 (66.7)	14 (66.7)	1
Q11: Do you know what types of problems untreated AF can cause? (Yes/No)	13 (51.9)	9 (42.9)	0.217
Q12: Do you know therapeutic strategies of AF? (Yes/No)	14 (66.7)	12 (57.1)	0.525
Q13: Do you know if there are any side effects of taking anticoagulant drugs? (Yes/No)	13 (51.9)	13 (61.9)	1
Knowledge of DCC			
Q1: The treatment efficacy of DCC can reach 100%	8 (38.1)	12 (57.1)	0.217
Q2: In normal conditions, the patient is allowed to go home after successful DCC	21 (100)	19 (90.5)	0.488
Q3: The patient is allowed to drive a vehicle during the first 24h after DCC	15 (71.4)	14 (66.7)	0.739
Q4: There is high chance for AF recurrence after successful DCC	19 (90.5)	19 (90.5)	1
Q5: There are no complications related to DCC if the patient takes anticoagulation medication a few weeks in advance (if prescribed by the physician)	15 (71.4)	12 (57.1)	0.334
Q6: The patient is allowed to eat and drink before DCC takes place	15 (71.4)	12 (57.1)	0.334
Q7: The goal of DCC is to terminate the arrhythmia	20 (95.2)	20 (95.2)	1
Q8: After successful DCC, the patient does not need to take medication anymore	20 (95.2)	17 (81.0)	0.343
Q9: Before DCC, a TEE examination can be performed	20 (95.2)	15 (71.4)	0.093
Q10: The patient will be sedated during DCC	20 (95.2)	19 (90.5)	1

Self-management activities			
Q1: Do you sometimes forget to take your medication? (Yes/No)	19 (90.5)	20 (95.2)	0.486
Q2: Have you ever reduced the dosage of your medication without requesting your physician?	20 (95.2)	20 (95.2)	1
Q3: Do you sometimes forget to take your medication with you?	20 (95.2)	20 (95.2)	1
Q4: Have you ever stopped taking your medication without requesting your physician?	20 (95.2)	21 (100)	1
Q5: Do you think taking medication on a schedule is troublesome?	21 (100)	18 (85.7)	0.230
Q6: Do you restrict alcohol intake?	20 (95.2)	18 (85.7)	0.340
Q8: Do you aim at losing weight according to your AF condition?	16 (76.2)	15 (71.4)	0.714
Q9: Do you monitor your pulse daily?	8 (38.1)	7 (33.3)	1
Q10: Do you do appropriate exercise according to your AF condition?	18 (85.7)	17 (81.0)	0.405

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*).
[a] one missing value (n=20) *AF* atrial fibrillation; *DCC* direct-current cardioversion; *TEE* transoesophagal echocardiography

Table 18: Results of the five-point Likert attitude scale at follow-up.

	Education (n=21)					**Usual care (n=21)**					**P-value**
	Score n (%)					**Score n(%)**					
Item	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
Q1	0 (0)	6 (28.6)	7 (33.3)	5 (23.8)	3 (14.3)	0 (0)	3 (14.3)	4 (19)	8 (38.1)	6 (28.6)	0.402
Q2	0 (0)	1 (4.8)	0 (0)	11 (52.4)	9 (42.9)	0 (0)	1 (4.8)	0 (0)	8 (38.1)	12 (57.1)	0.758
Q3	4 (19)	2 (9.5)	6 (28.6)	7 (33.3)	2 (9.5)	1 (4.8)	2 (9.5)	9 (42.9)	6 (28.6)	3 (14.3)	0.694
Q4	0 (0)	0 (0)	0 (0)	7 (33.3)	14 (66.7)	0 (0)	1 (4.8)	1 (4.8)	7 (33.3)	12 (57.1)	0.867
Q5	1 (4.8)	2 (9.5)	3 (14.3)	9 (42.9)	6 (28.6)	1 (4.8)	4 (19)	3 (14.3)	9 (42.9)	4 (19)	0.905
Q6	0 (0)	0 (0)	0 (0)	9 (42.9)	12 (57.1)	0 (0)	1 (4.8)	0 (0)	7 (33.3)	13 (61.9)	0.751
Q7	0 (0)	0 (0)	0 (0)	7 (33.3)	14 (66.7)	0 (0)	1 (4.8)	0 (0)	4 (19)	16 (76.2)	0.484
Q8	0 (0)	1 (4.8)	4 (19)	7 (33.3)	9 (42.9)	1 (4.8)	4 (19)	5 (23.8)	5 (23.8)	6 (28.6)	0.462

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*). *AF* atrial fibrillation
Q1: I think AF is a serious disease; Q2: I think AF will affect my quality of life if not treated; Q3: I am afraid of the complications of AF; Q4: Good adherence to a prescribed medication and/or lifestyle regimen can reduce uncomfortable symptoms caused by AF; Q5: If there is no embolic complication, it is unnecessary to take anticoagulant drugs; Q6: It is a waste of time for periodic follow-up; Q7: The guidance of the medical staff is more reliable than the information provided by newspaper, television or other media; Q8: I should monitor my pulse regularly in order to detect asymptomatic AF episodes in an early stage

Table 19: Patient's overall levels regarding knowledge of AF, knowledge of DCC, attitude concerning AF, and self-management activities before and after patient education.

Questionnaire	Max possible score	PRE-EDUCATION (n=21)			POST-EDUCATION (n=21)			P-value
		Score	Highest score (lowest score)	Percentage of score	Score*	Highest score (lowest score)	Percentage of score	
Knowledge of AF	13	9.00 (IQR 1.50)	13 (2)	69.23 (IQR 11.53)	11.00 (IQR 2.50)	13 (6)	84.62 (IQR 19.24)	**0.011***
Knowledge of DCC	10	9.00 (IQR 1.00)	10 (5)	90.00 (IQR 10.00)	9.00 (IQR 2.00)	10 (4)	90.00 (IQR 20)	0.861
Attitude regarding AF	40	32.67 ± 2.83	38 (27)	81.67 ± 7.09	32.48 ± 3.74	38 (26)	81.19 ± 9.34	0.796
Self-management	9	7.00 (IQR 2.00)	9 (2)	77.78 (IQR 22.22)	8.00 (IQR 1.50)	9 (3)	88.89 (IQR 16.66)	**0.031***

Data are presented as mean ± standard deviation for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. n: sample size. A P-value <0.05 was considered a statistically significant difference. *SD* standard deviation; *AF*; atrial fibrillation; *DCC* direct-current cardioversion.

Table 20: Patient's overall levels regarding knowledge of AF, knowledge of DCC, attitude concerning AF, and self-management activities before and after usual care.

Questionnaire	Max possible score	PRE-USUAL CARE (n=21)			POST-USUAL CARE (n=21)			P-value
		Score	Highest score (lowest score)	Percentage of score	Score	Highest score (lowest score)	Percentage of score	
Knowledge of AF	13	8.81 ± 2.56	13 (4)	67.77 ± 19.70	9.29 ± 2.31	13 (5)	71.43 ± 17.73	0.212
Knowledge of DCC	10	8.19 ± 1.08	10 (6)	81.90 ± 10.78	7.57 ± 1.99	10 (3)	75.71 ± 19.89	0.120
Attitude regarding AF	40	35.00 (IQR 3.50)	37 (29)	87.50 (IQR 8.75)	32.00 (IQR 3.50)	40 (27)	80.00 (IQR 8.75)	0.043*
Self-management	9	7.00 (IQR 2)	9 (4)	77.78 (IQR 22.22)	8.00 (IQR 1)	9 (4)	88.89 (IQR 11.11)	0.140

Data are presented as mean ± standard deviation for parametric continuous variables and as median and interquartile range (IQR) for non-parametric continuous variables. n: sample size. A P-value <0.05 was considered a statistically significant difference. *SD* standard deviation; *AF*; atrial fibrillation; *DCC* direct-current cardioversion.

Table 21: Patients non-cardiovascular risk factors and EHRA score at follow-up.

CHARATERISTICS	**EDUCATION (n=21)**	**USUAL CARE (n=21)**	**Total population (n=42)**	**P-value†**
Smoking				0.478
Yes	2 (9.5)	1 (4.8)	3 (7.1)	
Never	5 (23.8)	9 (42.9)	14 (33.3)	
Quit	14 (66.7)	11 (52.4)	25 (59.5)	
Alcohol usage (drinks/week)				0.270
0	10 (47.6)	11 (52.4)	21 (50)	
≤3	2 (9.5)	5 (23.8)	7 (16.7)	
3-8	6 (28.6)	5 (23.8)	11 (26.2)	
≥8	3 (14.3)	0 (0)	3 (7.1)	
Caffeine usage (drinks/day) – n (%)				0.758
0	5 (23.8)	3 (14.3)	8 (19)	
≤2	6 (28.6)	7 (33.3)	13 (31)	
2-6	10 (47.6)	7 (33.3)	17 (40.5)	
≥6	0 (0)	4 (19)	4 (9.5)	
EHRA score				0.442
Class I	16	13	29	
Class II	3	7	10	
Class III	2	1	3	
Class IV	0 (0)	0 (0)	0 (0)	

Data are presented as number of patients and percentage. n: sample size. *EHRA score* European Heart Rhythm Association score of AF-related symptoms. A P-value <0.05 was considered a statistically significant difference (*). † comparison between education and usual care

Table 22: Comparison of patient's non-cardiovascular risk factors between baseline and follow-up for the education group and the usual care group.

Non-cardiovascular risk factors – n (%)	EDUCATION (n=21)		P-value†	USUAL CARE (n=21)		P-value‡
	BASELINE	FOLLOW-UP		BASELINE	FOLLOW-UP	
Smoking			0.157			1
Yes	4 (19.0)	2 (9.5)		1 (4.8)	1 (4.8)	
Never	6 (28.6)	5 (23.8)		10 (47.6)	9 (42.9)	
Quit	11 (52.4)	14 (66.7)		10 (47.6)	11 (52.4)	
Alcohol usage (drinks/week)			**0.020***			0.317
0	6 (28.6)	10 (47.6)		2 (9.5)	11 (52.4)	
≤3	5 (23.8)	2 (9.5)		12 (57.1)	5 (23.8)	
3-8	4 (19.0)	6 (28.6)		6 (28.6)	5 (23.8)	
≥8	6 (28.6)	3 (14.3)		1 (4.8)	0 (0.0)	
Caffeine usage (drinks/day)			0.096			**0.046***
0	2 (9.5)	5 (23.8)		3 (14.3)	3 (14.3)	
≤2	8 (38.1)	6 (28.6)		3 (14.3)	7 (33.3)	
2-6	10 (47.6)	10 (47.6)		12 (57.1)	7 (33.3)	
≥6	1 (4.8)	0 (0.0)		3 (14.3)	4 (19.0)	

Data are presented as number of patients and percentage. n: sample size. A P-value <0.05 was considered a statistically significant difference (*).
† comparison between baseline and follow-up for the education group
‡ comparison between baseline and follow-up for the usual care group

Auteursrechtelijke overeenkomst

Ik/wij verlenen het wereldwijde auteursrecht voor de ingediende eindverhandeling:
Patient Education as an Important Factor in the Management of Atrial Fibrillation by Improving Self-Management Activities

Richting: **master in de biomedische wetenschappen-klinische moleculaire wetenschappen**
Jaar: **2015**

in alle mogelijke mediaformaten, - bestaande en in de toekomst te ontwikkelen - , aan de Universiteit Hasselt.

Niet tegenstaand deze toekenning van het auteursrecht aan de Universiteit Hasselt behoud ik als auteur het recht om de eindverhandeling, - in zijn geheel of gedeeltelijk -, vrij te reproduceren, (her)publiceren of distribueren zonder de toelating te moeten verkrijgen van de Universiteit Hasselt.

Ik bevestig dat de eindverhandeling mijn origineel werk is, en dat ik het recht heb om de rechten te verlenen die in deze overeenkomst worden beschreven. Ik verklaar tevens dat de eindverhandeling, naar mijn weten, het auteursrecht van anderen niet overtreedt.

Ik verklaar tevens dat ik voor het materiaal in de eindverhandeling dat beschermd wordt door het auteursrecht, de nodige toelatingen heb verkregen zodat ik deze ook aan de Universiteit Hasselt kan overdragen en dat dit duidelijk in de tekst en inhoud van de eindverhandeling werd genotificeerd.

Universiteit Hasselt zal mij als auteur(s) van de eindverhandeling identificeren en zal geen wijzigingen aanbrengen aan de eindverhandeling, uitgezonderd deze toegelaten door deze overeenkomst.

Voor akkoord,

Dreesen, Pauline

Datum: **9/06/2015**