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REVIEW ARTICLE

ASSESSMENT OF THE QUALITY OF LIFE IN PATIENTS WITH ATRIAL FIBRILLATION – CRITICAL VIEW ON THE CURRENT METHODS AND INSIGHTS FOR THE FUTURE

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Abstract
Atrial fibrillation (AF) represents the most common supraventricular arrhythmia of clinical significance associated with increased mortality and morbidity, especially stroke and heart failure. While AF is rarely life-threatening arrhythmia, the symptoms may vary from totally asymptomatic in up to a one third of affected population to severe symptoms deteriorating significantly patients' quality of life (QoL). There is currently no globally adopted guidelines on how to assess QoL in patients with AF and AF-associated QoL may be viewed from many perspectives, representing an extensive multidimensional construct. Numerous QoL instruments have been used in AF studies to date, again indicating the lack of general consensus. QoL measurement tools may be divided into two categories: generic instruments and AF-specific instruments or symptom scales. This minireview focuses on recently used questionnaires and proposing a novel, holistic method of QoL assessment in patients with AF.

Keywords: *Assessment; Atrial fibrillation; Generic instruments; Quality of life; Specific instruments*

Abbreviations:
AF – atrial fibrillation; AF-CHF – Atrial Fibrillation-Congestive Heart Failure; AF-QoL – Atrial Fibrillation Quality of Life; AF6 – Atrial Fibrillation Six questions; AFEQT – Atrial Fibrillation Effect on Quality of Life; AFFIRM – Atrial Fibrillation Follow-up Investigation of Rhythm Management; AFQLQ – Quality of Life of Atrial Fibrillation Questionnaire; AFSS – Atrial Fibrillation Severity Scale; CABANA – Catheter Ablation versus Antiarrhythmic Drug Therapy for Atrial Fibrillation; CCS-SAF – Canadian Cardiovascular Society Severity in Atrial Fibrillation Scale; CHA2DS2VASc – Congestive heart failure, Hypertension, Age2 ≥75 years, Diabetes, previous Stroke, Vascular disease, Age 65–74 years, Sex category; COSMIN – Consensus based Standards for Selection of health Measurement INstruments; CTAF trial – Canadian Trial of Atrial Fibrillation; EHRA – European Heart Rhythm Association; EQ-5D – Euro Quality-5 Dimensions; EuroQoL – Euro Quality of Life; FRACTAL – The Fibrillation Registry Assessing Costs, Therapies, Adverse events and Lifestyle; HF – heart failure; MCS – Mental component score; mEHRA – modified European Heart Rhythm Association scale; NR – non rated; NT-proBNP – N-terminal pro-brain natriuretic peptide; NYHA – New York Heart Association; PCS – Physical Component Score; PIAF – Pharmacological Intervention in Atrial Fibrillation; QLAF – Quality of Life in Atrial Fibrillation; QoL – quality of life; RACE trial – Rate Control versus Electrical Cardioversion for Persistent Atrial Fibrillation; MAZE – Heart Surgery for Atrial Fibrillation; SCL – Arrhythmia Symptom Checklist, Frequency and Severity; SF – Short-Form; STAF – Strategies of Treatment of Atrial Fibrillation; WHO – World Health Organization

INTRODUCTION

Atrial fibrillation (AF) represents the most common supraventricular arrhythmia of clinical significance (Hindricks et al., 2020) associated with increased mortality and morbidity, especially stroke and heart failure (HF) (Benjamin et al., 1998; Kannel et al., 1998; Wang et al., 2003). Its prevalence in the general population was estimated between 1-2% but the recent studies indicate that it may be as high as 4% (Heeringa et al., 2006; Lloyd-Jones et al., 2004; Piccini et al., 2012). This trend may be partly explained by the demographic transition to an inverted age pyramid, as frequency of AF increases with advancing age, but some studies demonstrated an increase in AF incidence even after age-adjustment, which is probably a result of more comorbidities and cardiovascular risk factors plus lifestyle changes (Chugh et al., 2001; Miyasaka et al., 2006). Recent comparative assessment of the burden of AF across defined time periods based on available epidemiological data clearly showed progressive increases in overall burden, incidence, prevalence and AF-associated mortality between 1990–2010 (Chugh et al., 2014). Justifiably, AF and HF are therefore being referred to as the most important epidemics of the 21st century.

While AF is rarely life-threatening arrhythmia, the symptoms may vary from totally asymptomatic in up to a one third of affected population to severe symptoms deteriorating significantly patients' quality of life (QoL). Typical symptoms include palpitations, dizziness, chest pain, diminished exercise tolerance, and dyspnea. However, even in initially asymptomatic patients the first visible consequence of the arrhythmia may be evolving HF or disabling stroke, both of those affecting significantly patients' QoL. In addition, treatment strategies associated with possible adverse effects, hospitalizations and social disabling may similarly have further negative impact on QoL. This minireview aims on summarizing the critical view on recently used questionnaires and highlighting a fact of their limited value in specific AF-associated QoL measurement after treatment interventions, proposing a novel, holistic method of QoL assessment in patients with AF.

MATERIALS AND METHODS

The data were searched in the PubMed, Scopus, Science Direct, and Web of Science databases between January 2000 and November 2020. The criteria were set for sources assessing the QoL in patients with AF. We used the following keywords: atrial fibrillation AND quality of life. Parallel sources were excluded. Of all publications in English language matching these criteria, 4 AF symptom scale instruments, 3 generic and 5 disease-specific QoL instruments were identified as most often used. Generic publications on these instruments including validation studies and studies focusing on the AF treatment strategies, in which these QoL assessment instruments were used, were thereafter searched and critically reviewed.

Factors influencing QoL in patients with AF

Health is defined by the World Health Organization (WHO) not only as an absence of disease or infirmity, but also as a state of complete physical, mental and social well-being, in other words life without disease with an acceptable QoL. Nevertheless, there is currently no globally adopted guidelines on how to assess QoL in patients with AF. AF-associated QoL may be viewed from many perspectives, like objectively measured biological functions, symptoms and/or functional status of the individual, level of his/her social interactions, need for therapeutical interventions, subjective general health perception, patient's expectations, self-assessment etc. AF, its consequences and their impact on QoL constitute an extensive multidimensional construct and inherently, this leads into absence of a quick, easy-to-use, and reproducible measurement tool of AF related QoL, which could be widely used in everyday clinical practice. Moreover, AF is often associated with other cardiovascular diseases (coronary artery disease, arterial hypertension, valvular diseases, cardiomyopathies, etc.) and the disease may dominate the patient´s preoccupations with health and QoL rather than the arrythmia itself. It is therefore important to separate the impact of other diseases on QoL from that of AF. In the FRACTAL study, for example, NYHA class,

valvular heart disease, and chronic pulmonary disease had the strongest impact on QoL scores (Reynolds et al., 2006) when assessed in patients with AF.

Available QoL instruments

Present instruments for QoL assessment in patients with AF have inherent limitations. First, lack of general acceptance among clinicians, hospital boards, health-care insurance companies as well as their subjectivity both from the patients' view and clinicians' view hamper significantly the willingness to use them in daily clinical practice. Type of AF (i.e. paroxysmal vs. persistent) also renders spontaneous variability in a patient's condition and may represent a significant confounder.

Numerous QoL instruments, which have been used in AF studies to date, may be divided into two categories: *generic instruments and AF-specific instruments or symptom scales*.

Generic instruments

Generic instruments have the advantage of having been extensively validated and also translated in many languages. They have been used in many trials aimed at numerous non-cardiac and cardiac diseases including AF. Their inherent disadvantage is that they measure general health status rather than disease-specific affection. These instruments are therefore widely influenced by patient demographics and comorbidities and some studies, like FRACTAL, for instance, literary advocated their avoidance in assessing QoL in patients with AF (Reynolds et al., 2006), especially due to the fact that these generic measures are by far less sensitive to any change in the vast population of older AF patients who have multiple health problems.

Generic QoL instruments are represented mainly by widely used Medical Outcome Study Short-Form Health Survey, known as SF-36 (Ware and Sherbourne, 1992), its derived Short Form-12 version (SF-12) (Ware et al., 1996), and the EuroQOL/EQ-5D, as a result of the last-updated questionnaire version of the EuroQOL working group (EuroQol Group, 1990) – Table 1.

The SF-36 consists of a 36-item questionnaire that assesses eight health concepts: general health perception, physical functioning, social functioning, role limitations due to physical problems, bodily pain, mental health, role limitations due to emotional problems, and vitality. In addition to these eight subscales, the SF-36 also generates physical (PCS) and mental component summary (MCS) scores.

The SF-12 was derived from the SF-36 by selecting only the 12 questions from the original survey that appeared to carry the most information (Ware et al., 1996). The PCS and MCS scores from the SF-12 have been shown to correlate highly with those derived from the SF-36.

The EuroQOL is a descriptive system covering five dimensions of health status: mobility, selfcare, usual activities, pain/discomfort, and anxiety/ depression, each rated on three levels ranging from "no problems" to "severe problems" (EuroQol Group, 1990). The survey is supplemented by the visual aid score from 0 to 100, 0 representing worst QoL and 100 representing the best QoL. The questionnaire has been extensively validated and has an additional advantage of having a well-accepted method (the EQ-5D) for transforming raw scores to preference-based utility weights.

Disease-specific instruments

Strengths of the AF-specific tools for measuring QoL in AF studies is their specificity: they enable to validate symptoms affecting QoL which are associated with AF and therefore these questionnaires are more sensitive to changes in patients' health status.

The most used is the Atrial Fibrillation Effect on Quality of Life (AFEQT) questionnaire (Spertus et al., 2011) based on 20 items grouped into 4 domains: symptoms (4 items), daily activities (8 items), treatment concerns (6 items), treatment satisfaction (2 items). Each item is ranked on a 7-point Likert scale from 1 = no symptoms (or troubles or limitations) to 7 = extreme symptoms (or troubles, limitations). The highest is the score, the lowest is the QoL, which reflects the combination of symptoms, functional status and satisfaction in a single number. Other AF-specific instruments include the AF6 questionnaire (Harden et al., 2009), the Atrial Fibrillation Quality of Life questionnaire (AF-QoL) (Badia et al., 2007), the Quality of Life of Atrial Fibrillation (AFQLQ) questionnaire (Yamashita et al., 2003), and the QoL in AF questionnaire (QLAF) (Braganca et al., 2010), details of which are synoptically summarized in Table 2.

Table 1 – Generic measurement tools for QoL assessment

Instrument	Measured domains	Scoring/ Scales	Advantages	Disadvantages
SF-36	● Limitations in physical activities due to health problems ● Bodily pain ● General mental status ● Limitations due to emotional problems ● Vitality ● General health perception	0–100 scoring system	● Widely used and validated instrument ● Used in variety of cardiac and non-cardiac diseases ● Translated and validated in many languages (incl. Czech language) ● Robust data collected on QoL in AF to date using SF-36 questionnaire	● Reflects general health functioning rather than AF-specific symptoms ● Scores highly influenced by demographic data and comorbidities ● Less sensitive in older AF patients with multiple comorbidities to detect improvement by any therapy
SF-12	● Limitations in physical activities due to health problems ● Bodily pain ● General mental status ● Limitations due to emotional problems ● Vitality ● General health perception	Summary scores for physical health and mental health standardized to population norms with the mean score set to 50	● Widely used and validated instrument ● Used in variety of cardiac and non-cardiac diseases ● Translated and validated in many languages (incl. Czech language) ● Reasonable data collected on QoL in AF to date using SF-12 questionnaire	● Reflects general health functioning rather than AF-specific symptoms ● Scores highly influenced by demographic data and comorbidities ● Less sensitive in older AF patients with multiple comorbidities to detect improvement by any therapy
EQ5D	● Mobility ● Self-care ● Pain or discomfort ● Anxiety or depression ● Complemented by visual aid score	Three scale range: ● No problems ● Some problems ● A lot of problems Visual aid score from 0 (worst health) to 100 (best health)	● Extensively validated ● Easy to use ● Generalizability ● Translated and validated in many languages (incl. Czech language) ● Has well-accepted method for transforming raw scores to preference-based utility weights ● Extensive data on AF collected using EQ5D	

The recent systematic review of the measurement properties of disease specific patient-reported outcome measures focusing on QoL in patients with AF assessed several studies, which designed and validated the questionnaires "with aim to provide clinicians with an understanding of whether these instruments would likely be of value in research and clinical practice" (Kotecha et al., 2016). A comprehensive methodology from the Consensus based Standards for selection of health Measurement Instruments (COSMIN) group (Terwee et al., 2012), which includes rigorous assessment of validity, reliability, and responsiveness of QoL questionnaires was used in this meta-analysis. The results were quite disappointing. Although good reliability (internal consistency and test-retest reliability) was demonstrated for AF6, AFEQT, AFQLQ and AFQoL, content, construct and criterion validity were positively rated only in AFEQT. Responsiveness was positively rated again only in AFEQT (Table 3). These results clearly showed that virtually no single questionnaire can be recommended for the wide clinical use. Although the AFEQT performed the best, further evidence for test-retest reliability, measurement error and responsiveness are still required.

Table 2 – AF-specific measurement tools for QoL assessment

Instrument	Measured domains	Scoring/ Scales	Advantages	Disadvantages
AFEQT	QoL assessment based on 6 domains ● Symptoms ● Social functioning ● Physical functioning ● Emotional functioning ● Treatment concerns ● Treatment satisfaction	Five-point Likert scale (from 1 = totally agree to 5 = totally disagree)	● Applicable to all types of AF ● Best documented reliability, validity and responsiveness among all AF- specific instruments	● Conflicting findings on reproducibility
AF6	Six questions: ● Dyspnea at rest ● Dyspnea during exertion ● Limitations in daily life due to AF ● Discomfort ● Fatigue ● Worry or anxiety	Eleven-point Likert scale (0 = no limitations, 10 = completely limited)	● Easy to use ● Applicable to all types of AF ● Relatively consistent and reliable	● Used only in two studies on Swedish population ● Unknown reproducibility and responsiveness
AFQoL	Based on three domains: ● Psychological ● Physical ● Sexual activity	Five-point Likert scale (from 1 = totally agree to 5 = totally disagree) Scoring 0–100 0 = worst QoL 100 = best QoL	● Able to capture change over time	● Uncertain generalizability ● Scores more prone to patients' demographics
AFQLQ	● Variety and frequency of symptoms (questions 1–6) ● Severity of symptoms (questions 7–12) ● Limitation of daily and special activities and mental anxiety (questions 13–26)	Scales: ● Physical functioning ● Role functional-physical ● Role functional-emotional ● Bodily pain ● General health perceptions ● Vitality ● Social functioning ● Mental health Subscales are transformed to create Physical and Mental Component Summary, range 0–100 points The higher is the score, the better is the QoL	● Fair reliability ● Internally consistent	● Unknown validity ● Uncertain generalizability ● Time-consuming
QLAF	● Palpitation ● Breathlessness ● Chest pain ● Dizziness ● Drugs ● Direct-current cardioversion ● Ablation	Domains numbered sequentially (I–VII) Questions containing items scored (1–22) Yes/No questions not scored The higher is the score, the worse is QoL	● Simple ● Practical ● May be rapidly administered and used in out-patient departments	● Poorly defined reliability, validity and responsiveness ● Uncertain generalizability

Table 3 – Assessment of the current AF-specific QoL tools used in patients with AF (adapted from Kotecha et al., 2016)**. AFEQT performed best in majority of criterions**

Measurement property	Detailed performance	AFEQT	AF6	AFQoL	AFQLQ	QLAF
Reliability	Internal consistency	+++	+	+	+	?
	Test-retest reliability	+/–	?	+/–	+	+
	Measurement error	NR	NR	NR	NR	NR
Validity	Content validity	+++	?	+++	NR	?
	Structural validity	+	+	+	+	NR
	Hypothesis testing	+	?	?	NR	?
	Intercultural usefulness	NR	NR	NR	NR	NR
	Criterion validity	+	?	+/–	NR	?
Responsiveness	Responsiveness	+	?	?	?	?

+++ strong positive evidence, ++ moderate positive evidence, + limited positive evidence, – – – strong negative evidence, – – moderate negative evidence, – limited negative evidence, +/– conflicting findings, ? unknown due to poor methodological quality of the current studies, NR non rated due to lack of sufficient data.

Symptom scales

As the main goal of almost all AF interventions is relief of symptoms, symptoms scales had to be developed to assess the effect of the treatment. The most commonly used symptom scales for AF include the Arrhythmia Symptom Checklist, Frequency and Severity (SCL) (Bubien et al., 1996), the University of Toronto Atrial Fibrillation Severity Scale (AFSS) (Dorian et al., 2002), recently advised European Heart Rhythm Association (EHRA) classification of AF-related symptoms (European Heart Rhythm Association et al., 2010), and the Canadian Cardiovascular Society Severity in Atrial Fibrillation Scale (CCS-SAF) (Dorian et al., 2006) – Table 4.

The SCL is relatively complex, but sensitive scale, which has been used in many clinical trials to date. Unfortunately, some of the symptoms are not AF-specific and the assessment of the functional status is also lacking. The AFSS is similarly complex to use and both these scales are relatively time-consuming to evaluate, which makes them impracticable to use in daily clinical practice. On the other hand, EHRA scale is very simple and straightforward, but its validation has not been fully completed yet. Modified EHRA scale (mEHRA) could be a better tool for indication of rhythm control strategies starting from levels IIb and more severe (Wynn et al., 2014) – Table 5. Similarly, the CCS-SAF tried to find a balance between aptness, simplicity and comprehensiveness and was found to be a simple semiquantitative scale that closely approximates patient-reported subjective measures of QoL (Dorian et al., 2009).

Impact of therapeutical interventions on QoL

Many clinical trials to date confirmed that patients with AF suffer from marked impairments of QoL compared to healthy controls (Carlsson et al., 2003; Hagens et al., 2004), population norms (Erdogan et al., 2003; Kang and Bahler, 2004) and patients with other cardiovascular diseases like ischemic heart disease (Dorian et al., 2000). Women with AF consistently reported worse QoL and more prominent perception of AF burden compared to their men counterparts in the CTAF trial (Paquette et al., 2000), RACE trial (Rienstra et al., 2005) and also in the older cross-sectional study encompassing more than 5000 Europeans with recently documented AF (Dagres et al., 2007). This finding persisted even after an extensive adjustment for baseline demographic and comorbid health conditions (Reynolds et al., 2006).

To date, there are only limited data concerning QoL in general population of patients with AF (Kang and Bahler, 2004), since most

Table 4 – Symptom scales for assessment of patients with AF

Instrument	Measured domains	Scoring/ Scales	Advantages	Disadvantages
Arrhythmia Symptom Checklist, Frequency and Severity (SCL)	16 items – symptoms associated with AF	Frequency: from 0 to 4 Severity: from 1 to 3 Frequency and severity scores not combined	● Straightforward ● Sensitive to change ● Used in many trials	● Uncertain generalizability ● Complex to use, time consuming ● Some symptoms not AF-specific
University of Toronto Atrial Fibrillation Severity Scale (AFSS)	9 items: ● Total AF burden = AF frequency + AF duration + AF severity ● Global well-being ● Healthcare utilization ● Demographic data ● Current AF status	Symptoms are scored on 5-point Likert scale, total score ranges from 0 to 35 (higher score = more severe symptoms	● Sensitive to change ● Used in many trials	● Uncertain generalizability ● Complex to use, time consuming
European Heart Rhythm Association (EHRA) classification	Symptoms are only attributable to time spent in AF	EHRA ● I = no symptoms ● II = mild symptoms ● III = severe symptoms ● IV = disabling symptoms	● Simplicity	● Limited clinical data in terms of validity, reliability and responsiveness ● Difficult for tracking changes over time
Canadian Cardiovascular Society Severity in Atrial Fibrillation Scale (CCS-SAF)	● Symptoms (palpitations, dyspnea, dizziness, presyncope or syncope, chest pain, fatigue) ● Association (determine, whether symptoms and AF are linked) ● Functionality (determine, whether symptoms affect patient's QoL)	Four-point scale: ● 0 = asymptomatic ● 1 = minimal effect on QoL ● 2 = minor effect on QoL ● 3 = moderate effect on QoL ● 4 = severe effect on QoL	● Easy to use at the bedside, relatively simple semiquantitative scale ● Achieved balance btw simplicity, aptness and comprehensive-ness	● Uncertain generalizability ● May be affected by subjective assessment of the clinician

Table 5 – Modified EHRA (mEHRA) scoring system (adapted from Wynn et al., 2014)

mEHRA score	Symptoms	Description
1	None	
2a	Mild	Normal daily activity not affected; symptoms not troublesome to patient
2b	Moderate	Normal daily activity not affected but patient troubled by symptoms
3	Severe	Normal daily activity affected
4	Disabling	Normal daily activity discontinued

of the data on QoL were generated in a highly preselected population of patients undergoing different therapeutical interventions including ablation, pacemaker implantation, direct current cardioversion, MAZE operation or percutaneous left atrial appendage closure. Open-label strategies in many of these trials (inevitably in all interventional trials) may also have introduced another bias towards the therapy-influenced QoL scores. The data presented in the following text must therefore been interpreted with extreme caution.

Rate vs. rhythm control strategy

Rate vs. rhythm control strategy represented a "hot" topic at the turn of the millennium. Five

major randomized controlled studies (STAF (Carlsson et al., 2003), PIAF (Hohnloser et al., 2000), RACE (Hagens et al., 2004), AF-FIRM (Jenkins et al., 2005) and AF-CHF (Suman-Horduna et al., 2013) trials) published in the first decade of the 21st century comparing pharmacological rate control vs. antiarrhythmic drugs showed moderate improvement in QoL during follow-up in both strategies, but with no significant difference between them. QoL in these trials was only one of the secondary outcomes, even though, in general, results from these studies indicate that strategy of rate control can be at least as effective as the aim to convert AF into a normal sinus rhythm and its maintenance. Methodologically, it is important to highlight that follow-up in these trials was quite short (6 months or less), some of them were not powered to detect a difference between QoL in study arms (only AF-FIRM and AF-CHF were so), and the cohort of patients were not highly symptomatic in terms of arrhythmia, which caused reduced sensitivity of the studies to detect a change between the treatment strategies, moreover taking into account the usage of non-validated instruments (usually generic) for QoL assessment.

Ablation for AF

Numerous non-pharmacological approaches in the AF treatment were shown to improve QoL, mainly in non-randomized setting, including direct current cardioversion (Berry et al., 2001), MAZE procedures (Lonnerholm et al., 2000) and catheter ablations (Chen et al., 2004; Hsu et al., 2004; Pappone et al., 2003; Weerasooriya et al., 2005). Typically, subjects of these studies were younger, men, highly symptomatic (therefore indicated for the invasive procedure) and with previously failed antiarrhythmic drugs. Not surprisingly, the magnitude of positive change in QoL was usually quite large (average increase by 20–40 points in the SF-36 scale, which has the max. 100 points).

However, these effects were sustained also in the randomized setting, whether the ablation was compared with antiarhythmic drugs (Wazni et al., 2005) or direct current cardioversion (Oral et al., 2006). CABANA, the largest (N = 2204) randomized trial to date on the ablation treatment of AF published in 2019 clearly showed that catheter ablation, compared with medical therapy, led to clinically important and significant improvements in quality of life at 12 months following the procedure (Mark et al., 2019).

Although the result of these trials seems to be persuasive, they should be interpreted with a caution. First of all, we need to be aware of the fact that some episodes of AF are rendered asymptomatic following catheter ablation (Hindricks et al., 2005). Second, by planning an invasive procedure creates some degree of expectations in patients that their health conditions should or must improve. This expectation bias may influence the results of QoL questionnaires. It has been credibly shown that even "sham" cardiac procedures can improve patients' well-being (Sud et al., 2007). Therefore, when studying the results of these trials, one should meticulously review the methodology, especially whether the patients were unaware of their randomization when completing their baseline QoL assessment and whether they were blinded to the objective monitoring results prior filling in the questionnaires during the whole follow-up. Of course, implementation of the "sham" procedures in the randomized studies would eliminate this bias, however, it is unrealistic due to impracticability and even ethical concerns.

Despite these caveats, we may conclude that catheter ablation of AF is more effective than antiarrhythmic drugs for rhythm control, and regarding QoL available data suggest that successful procedures are associated with large gains in QoL, mainly in highly symptomatic patients.

Future directives

As numerous variables are affecting QoL in patients with atrial fibrillation, we deeply think that for the purpose of future clinical trials, these predictors should be reorganized into domains and investigated in a complex, holistic model. Ferans et al. have recently advised a revision of Wilson and Cleary model of health-related QoL, which we consider appropriate for this purpose (Ferrans et al., 2005). According to this model, we might divide variables, which are known to significantly affect QoL in AF patients in so far published clinical studies, into following domains:

(1) Biological function
    a. Left ventricular ejection fraction
    b. Diastolic dysfunction

   c. Left atrial diameter
   d. Heart rate (min, mean, max)
   e. Previous stroke with consequences
   f. CHA_2DS_2VASc score
   g. NT-proBNP (brain natriuretic peptide) serum levels
   h. Duration of AF
(2) Symptoms
   a. Frequency and severity of symptoms
   b. Depression
   c. Anxiety
   d. Perceived stress, uncertainty
(3) Functional status
   a. Exercise performance
   b. NYHA class
(4) General health perception
   a. Fear of AF attack
   b. Perception of illness
   c. Emotional distress – anxiety, fear of stroke, etc.
   d. Feeling uninformed and unsupported
   e. Acceptance of the disease (positive coping with AF)
   f. Impaired social life
   g. Sexual problems
(5) Characteristics of an individual
   a. Age
   b. Gender
   c. Alcohol use
   d. Employment
   e. Sleep
   f. Personal characteristics
   g. Regular physical exercise
(6) Characteristics of the environment
   a. Feeling being significant burden to others (family, friends, ...)
   b. Financial burden

The biological domain reflects the major pathophysiological changes involved in AF and combination of all these parameters represent a "background", starting point determining either better or lesser quality of subjective well-being, the clinical manifestation of which are represented by symptoms. Symptoms were found to be the most important factor affecting QoL in AF patients in numerous trials (Rienstra et al., 2012) and importantly, may vary differently based on the paroxysmal vs. persistent nature of the arrhythmia. In patients with paroxysmal AF, for instance, the level of anxiety and fear of AF attack is significantly higher compared to the counterparts with persistent AF (Peinado et al., 2010; Thrall et al., 2007). Assessment of overall functional status as a subjective parameter is also important because correlation between objective performance of the cardiovascular system and functional status as its subjective reflection is only weak. General health perception is also affected by the perception of the illness as such and positive (or negative) coping strategies, incl. impaired social life, sexual dysfunction, feeling forsaken, etc. Characteristics of the surrounding environment as well as personal characteristics are framing the global context of the QoL of an individual with AF. As presented above, the subjective feeling of the QoL of a patient with AF is multifactorial, and to describe it in a single value, a comprehensive AF-specific novel model based of the most important of the above-mentioned variables should be constructed in the future to reflect the reality of patients with AF and the influencing factors and to, perhaps, assess specific AF-focused interventions. Such model's validity, reliability and responsiveness should be afterwards tested in a large scale before adoption in the research projects.

CONCLUSIONS

Growing AF burden, clinical significance of its QoL hampering consequences and novel treatment strategies impose a critical view on the currently used assessment of QoL in different patient cohorts, underlining the adequate measurement properties. Bearing this in mind, finding of an optimal model of the QoL assessment may differ with respect to the purpose of its use: everyday clinical practice vs. research projects aimed at the assessment of the AF-focused interventions. For the latter, a novel, holistic method of QoL assessment in patients with AF is needed.

Conflict of interests

The authors have no conflict of interests to declare.

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