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Original research article

Quality of life of patients with structural heart disease undergoing concomitant CryoMaze procedures for persistent atrial fibrillation – randomised comparison of a hybrid approach and CryoMaze alone

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Abstract
Aims: We aimed to compare patients' quality of life (QoL) after two types of atrial fibrillation (AF) treatment: a hybrid ablation strategy and a surgical CryoMaze procedure alone.
Methods and results: Patients with non-paroxysmal AF undergoing coronary artery bypass grafting and/or valve repair/replacement with concomitant CryoMaze procedure were randomly assigned to undergo either radiofrequency catheter ablation after three months (Hybrid Group) or no further treatment (Surgery Group). QoL was compared using the Atrial Fibrillation Effect on Quality of Life (AFEQT) questionnaire. The AFEQT score was converted to the scale of 0 to 100 per cent points, *i.e.*, a score of 0 corresponds to complete disability (or responding "extremely" limited, difficult, or bothersome to all questions answered), and a score of 100 corresponds to no disability (or responding "not at all" limited, difficult, or bothersome to all questions answered). In 106 Hybrid Group patients and 109 Surgery Group patients, both baseline and 12-month AFEQT data were available for final analysis. Patients' QoL did not differ between the Hybrid and Surgery Groups at baseline. At 12 months post-procedure, QoL improved significantly in both groups (from 61.9 ± 16.3 to 86.5 ± 13.4 and from 58.6 ± 14.9 to 81.5 ± 16.7 in the Hybrid Group and Surgery Group, respectively, $P < 0.001$). The 12-month AFEQT score was significantly higher in the Hybrid Group compared to the Surgery Group ($P = 0.017$). In an analysis based on AF recurrence, the QoL at 12 months was significantly higher in patients without AF recurrences compared to patients with AF recurrences (86.2 ± 14.0 vs 80.2 ± 16.8, $P = 0.005$).
Conclusion: Compared to the CryoMaze procedure alone, the hybrid ablation strategy was associated with higher QoL 12 months post-procedure in patients with non-paroxysmal AF undergoing cardiac surgery for structural heart disease. Arrhythmia recurrence was the most significant denominator of the QoL after concomitant AF surgery.

Keywords: AFEQT; Atrial fibrillation; Catheter ablation; Hybrid ablation; Maze procedure; Quality of life

Introduction

Atrial fibrillation (AF) is associated with increased mortality and morbidity (Benjamin et al., 1998; Kannel et al., 1998). In patients indicated for cardiac surgery, the prevalence of AF is higher than in the general population and is as high as 50% in individuals with mitral valve disease (Banach et al., 2008; Grigioni et al., 2002). Both surgical and radiofrequency catheter ablation (RFCA) procedures have become recognised treatments for AF. Surgical ablation consists of a pre-defined set of lesions in both atria (Cox MAZE IV procedure). Currently, the procedure is performed using either cryothermal tissue destruction, also called CryoMaze, or radiofrequency energy

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(RF) (Gammie et al., 2005). The CryoMaze procedure is usually done in conjunction (*i.e.*, concomitant cryoablation) with a coronary artery bypass or valve surgery.

Quality of life (QoL) is a subjective measure of a patient's health perceptions and functional status. Patients suffering from AF usually report poorer QoL than their counterparts without arrhythmias, mainly due to physical, mental, and social limitations (Carlsson et al., 2003; Erdogan et al., 2003; Hagens et al., 2004; Kang and Bahler, 2004). The symptoms may vary from totally asymptomatic in up to one-third of the affected population to severe symptoms that significantly deteriorate patients' QoL. Numerous non-pharmacological approaches in the AF treatment were shown to improve QoL, mainly in non-randomized settings, including CryoMaze procedures (Lönnerholm et al., 2000), RFCA (Fiala et al., 2014; Pappone et al., 2003; Weerasooriya et al., 2005), and even hybrid procedures utilising thoracoscopic epicardial ablation as a first-step stand-alone AF treatment supplemented by RFCA (Osmancik et al., 2020). CABANA, the most prominent randomised trial on the ablation treatment of AF, which included more than 2,200 patients, showed that RFCA, compared to medical therapy, led to clinically important and significant improvements in QoL at 12 months following the procedure (Mark et al., 2019). Nevertheless, there is a paucity of data concerning QoL in hybrid procedures, particularly those focusing on patients undergoing concomitant AF surgery, and there has been no randomised trial on QoL comparing the hybrid approach to CryoMaze alone. Therefore, our trial aimed to investigate the impact of a hybrid ablation strategy on the QoL in a cohort of patients with non-paroxysmal AF and structural heart disease undergoing CryoMaze together with bypass grafting and/or valve repair or replacement. The present study is a substudy of the Sequential HYBrid Ablation versus SURgical CryoMaze Alone for Treatment of Atrial Fibrillation Trial (SURHYB Trial).

Materials and methods

The SURHYB Trial was conducted as an investigator-initiated, multicentre, open-label, parallel-group, randomised controlled trial in 7 major complex cardiovascular centres in the Czech Republic. The trial protocol was approved by the institutional ethics committees at all participating institutions. The trial followed the Helsinki Declaration of 1964, its later amendments, and the Good Clinical Practice Guidelines. Written informed consent was obtained from all patients before enrolment. The SURHYB Trial was sponsored by the Czech Ministry of Health via a research grant from the Czech Health Research Council (registration No NV19-02-00046). The trial was registered in the Czech Clinical Trials Registry, cz-020420181253 (accessible at www.ablace.cz).

The details of the trial design and primary results have been published (Bulava et al., 2023, 2024). In brief, the main trial inclusion criteria comprised: (1) age >18 years, (2) symptomatic, non-paroxysmal AF, and (3) indication for cardiac surgery (coronary artery bypass grafting, valve surgery, or a combination of both). Main exclusion criteria were AF secondary to a reversible cause, left atrial (LA) diameter (in parasternal long axis view) >55 mm, previous surgical or catheter ablation for AF or atrial tachycardia (AT), advanced chronic kidney disease (Stage ≥4), contraindication to systemic anticoagulation, estimated life expectancy <1 year, and inability to mentally/physically comply with all trial requirements.

The CryoMaze procedure protocol consisted of mandatory circular lesions around the ipsilateral right and left pulmonary veins with linear lesions between the superior and inferior pulmonary veins to isolate the LA posterior wall. A mitral isthmus ablation line was created in all patients from the inferior connecting lesion towards the mitral annulus. In addition, the ligament of Marshall was cut off in all patients and the LA appendage was excluded in patients with a CHA_2DS_2-VASc score ≥2. In these patients, an extension line from the left superior pulmonary vein to the remnant of the left atrium was also created. The right atrium cryo-lesions were performed at the discretion of the surgeon. An implantable cardiac monitor (ICM) with telemonitoring capabilities and everyday ECG transmission (Biomonitor 2-AF and later Biomonitor III, Biotronik, Germany) was implanted before hospital discharge. The telemonitoring function of the device was enabled, and the patient unit (Cardiomessenger) was distributed to all patients.

Patients were randomly assigned in a 1 : 1 ratio to (i) *the Hybrid Group* or (ii) *the Surgery Group*. Randomisation was performed post-operatively (before discharge from the hospital), which ensured that the surgeons performing CryoMaze were blinded to treatment group allocation at the time of surgery. Participants in the Surgery Group (control group) received surgical CryoMaze only. Patients randomised to the Hybrid Group were admitted for a staged RFCA 90 (80–100) days after the surgical procedure. Dense electroanatomic mapping of the left and eventually right atria was performed using a CARTO3 navigation system and a Thermocool SmartTouch® ablation catheter (Biosense Webster, Inc., USA) to provide information about the location of the cryolesions. The goal was to close all gaps in circular and linear lines using RF energy and create a CTI block. Finally, all procedural ATs, spontaneous or induced, were mapped and ablated. CryoMaze and RFCA were considered *index procedures* in the Surgery and Hybrid Groups. Patients were seen at outpatient clinics 3, 6, and 12 months after the index procedure, and after that, every six months. The database was locked, and data was analysed when the last included patient reached a 12-month follow-up.

The Atrial Fibrillation Effect on Quality of Life (AFEQT) questionnaire was used to assess the QoL at baseline before randomisation and 12 months after the index procedure (Spertus et al., 2011). AFEQT is based on 20 items grouped into four domains: symptoms (4 items), daily activities (8 items), treatment concerns (6 items), and treatment satisfaction (2 items). Each item is ranked on a 7-point Likert scale from 1 = no symptoms (troubles or limitations) to 7 = extreme symptoms. AFEQT questionnaires were completed at baseline and after 12 months. Only patients with valid baseline and 12-month questionnaires were included in this final analysis. For better interpretation, the particular domain and overall scores were converted into percentage points of QoL (hereafter also referred to as "points" or "percent points"), *i.e.*, a score of 0 corresponds to complete disability (or responding "extremely" limited, difficult, or bothersome to all questions answered). In contrast, a score of 100 corresponds to no disability (or responding "not at all" limited, difficult, or bothersome to all questions answered). Thus, the spectrum of the QoL is readily imaginable thanks to the continuum from 0 percent points to 100 percent points. The formula used for the conversion of points into percentage points of the QoL was:

$$\text{QoL (\%points) in the particular domain} = 100 - \frac{(\text{SUM-NoQ})^* 100}{\text{NoQ} * 6}$$

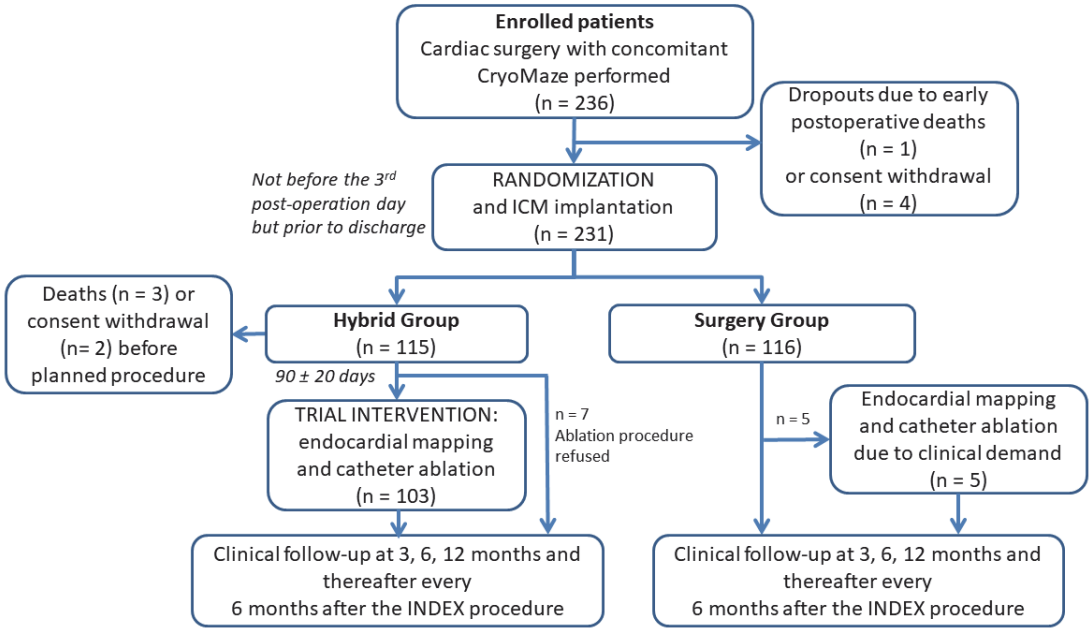
where SUM represents the sum of the points in the domain as indicated by the patient, and NoQ is the number of questions in the respective domain.

Statistical analysis

Continuous variables are reported as means with standard deviation (SD) or medians with interquartile range (IQR) and compared between the trial groups by a *t*-test for independent samples. Categorical variables are reported as frequencies and proportions and compared between the trial groups by the chi-square test. The null hypothesis (no difference between treatment groups) was rejected by a 2-sided test at the significance level 0.05. The QoL assessment, as one of the secondary clinical outcomes of the SURHYB Trial presented in this article, followed the intention-to-treat (ITT) principle. Thus, patients were assessed within the group into which they were randomised irrespective of the treatment received. This principle was also applied to patients from the Hybrid Group (i) who refused the RFCA but remained in the trial, (ii) in whom the RFCA procedure was prematurely aborted, and (iii) to patients from the Surgery Group in whom the bail-out RFCA was ultimately performed for intractable AF/AT. The statistics were conducted using software R, version 4.3.1. A second statistician reproduced the primary analysis using SAS Software, version 9.3 (SAS Institute, Cary, North Carolina).

Results

The CONSORT flowchart of the progress through the phases of the SURHYB trial is shown in Fig. 1. Altogether 236 patients were enrolled at seven sites between May 1, 2019, and March 31, 2022. Due to early postoperative deaths or informed consent withdrawal, 115 and 116 patients were finally assigned to the Hybrid and Surgery Groups, respectively. In the Hybrid Group, two patients withdrew their consent to the trial before the scheduled RFCA, three patients died before the planned RFCA (82 ± 27 days after the cardiac surgery procedure), one patient died after RFCA, and three patients withdrew their informed consent after RFCA but before 12-month follow-up could be completed. In the Surgery Group, three patients died, and four patients withdrew their informed consent before the 12-month follow-up could be accomplished. All these patients were excluded, so 106 and 109 patients in the Hybrid Group and Surgery group, respectively, were finally analysed.



Note: ICM – implantable cardiac monitor.

Fig. 1. CONSORT diagram of the SURHYB Trial

The cross-over rates were relatively modest. Seven patients from the Hybrid Group refused to undergo RFCA, but they continued in the trial follow-up. Five patients from the Surgery Group underwent RFCA (7.3 ± 1.8 months after the index procedure) because of the recurrence of intolerable AF/AT resistant to a rhythm or rate control pharmacological therapy.

Baseline demographic and clinical characteristics were well-balanced between trial groups (Table 1). Patients had a mean age of 68.5 years; 69% were males, and 55% had long-standing persistent AF. The mean continuous AF duration before inclusion in the trial was 2.3 ± 2.8 years. Current or prior ineffective use of Class IC or Class III AADs was documented in 90% of patients.

At baseline, QoL was similar between the Hybrid and Surgery Groups, reaching 61.9 ± 16.3 percent points and 58.6 ± 14.9 percent points, respectively (P = 0.121). Average QoL self-assessment ranged between 46 and 69 percent points in all four domains of AFEQT (Table 2). In both groups, there was a significant improvement in global QoL after cardiac surgery or RFCA to 86.5 ± 13.4 percent points in the Hybrid Group and 81.5 ± 16.7 percent points in the Surgery Group (P < 0.001 for both groups). In the Hybrid Group, the median QoL regarding symptoms, daily activities, treatment concerns, and treatment satisfaction improved by 23 (IQR: 8–38), 30 (IQR: 15–46), 22 (IQR: 6–39), and 17 (IQR: 0–33) percent points, respectively. Similarly, in the Surgery Group, the median QoL regarding symptoms, daily activities, treatment concerns, and treatment satisfaction improved by 17 (IQR: 4–37), 27 (IQR: 12–48), 22 (IQR: 6–36), and 17 (IQR 0–33) percent points, respectively. QoL was significantly better in the Hybrid Group compared

Table 1. Baseline clinical characteristics

	Hybrid Group n = 113	Surgery Group n = 116	Total population n = 229
Age (years)	68.5 ± 7.2	68.6 ± 7.1	68.5 ± 7.4
Male	80 (70.8)	79 (68.1)	159 (69.4)
Body mass index (kg/m^2)	30.8 ± 4.9	31.2 ± 5.3	31.0 ± 5.1
Persistent atrial fibrillation	57 (50.4)	47 (40.5)	104 (45.4)
Long-standing atrial fibrillation	56 (49.6)	69 (59.5)	125 (54.6)
Congestive heart failure	90 (79.6)	91 (78.4)	181 (79.0)
NYHA Class			
I	10 (8.8)	10 (8.6)	20 (8.7)
II	44 (38.9)	36 (31.0)	80 (34.9)
III	34 (30.1)	44 (37.9)	78 (34.1)
IV	2 (1.8)	1 (0.9)	3 (1.3)
CHA_2DS_2-VASc score			
0–2	19 (16.8)	21 (18.1)	40 (17.5)
3–5	78 (69.0)	80 (69.0)	158 (69.0)
6–9	16 (14.2)	15 (12.9)	31 (13.5)
Left atrium diameter (cm)	4.8 ± 0.5	4.8 ± 0.5	4.8 ± 0.5
Left ventricular ejection fraction (%)	56.9 ± 11.5	54.6 ± 10.1	55.8 ± 10.8
History of electrical cardioversion	48 (42.5)	50 (43.1)	98 (42.8)
Arterial hypertension	96 (85.0)	105 (90.5)	201 (88.9)
Diabetes mellitus	40 (35.4)	43 (37.1)	83 (36.2)
Coronary artery disease	49 (43.4)	50 (43.1)	99 (43.2)
Transient ischemic attack / Stroke	14 (12.4)	12 (10.3)	26 (11.4)

Note: Values are the number (percentage) of patients or mean ± standard deviation.

Table 2. Quality of life (QoL) as assessed by the AFEQT questionnaire

	Hybrid group n = 106	Surgery group n = 109	P
Baseline assessment (percent points)			
Symptoms	69.5 ± 19.1	68.5 ± 20.8	0.716
Daily activities	51.3 ± 22.5	46.0 ± 22.7	0.089
Treatment concerns	69.0 ± 17.9	66.2 ± 19.0	0.260
Treatment satisfaction	68.2 ± 18.1	66.4 ± 15.8	0.437
Global	61.9 ± 16.3	58.6 ± 14.9	0.121
12-month assessment (percent points)*			
Symptoms	92.3 ± 11.5	88.3 ± 15.5	**0.034**
Daily activities	79.8 ± 19.2	74.8 ± 23.8	0.092
Treatment concerns	90.9 ± 14.1	86.6 ± 16.9	**0.046**
Treatment satisfaction	88.6 ± 13.4	79.7 ± 22.5	**0.001**
Global	86.5 ± 13.4	81.5 ± 16.7	**0.017**

Note: The AFEQT scores were converted into percent points of QoL, *i.e.*, no symptoms corresponded to 100 percent points (the best, *i.e.*, 100% QoL), and most severe symptoms corresponded to 0 percent points (the worst, *i.e.*, 0% QoL), * P values for baseline vs. 12-month assessment are <0.001 globally and for all domains in both treatment groups.

to the Surgery group 12 months after the index procedures regarding symptoms, treatment concerns, and treatment satisfaction (Table 2). However, the assessment of daily activities was not significantly different. The 12-month global QoL was also higher in the Hybrid Group compared to the Surgery Group (86.5 ± 13.4 vs 81.5 ± 16.7 percent points, P = 0.017).

Subsequent analysis of the QoL was performed in both study groups depending on whether the patients objectively had any recurrent AF/AT over the first 12 months following the index procedure. Patients with recurrent AF/AT had significantly worse QoL in all AFEQT domains except for treatment satisfaction (Table 3). Global QoL was also worse in those with recurrent AF/AT (80.2 ± 16.8 vs 86.2 ± 14.0 percent points, P = 0.005).

Major procedural complications of RFCA, defined as those that result in permanent injury or death, require intervention, or prolong or require hospitalisation, were present in 2 (1.9%) patients after RFCA. One femoral pseudoaneurysm was treated by thrombin injection without sequelae, and the case of haematuria prolonging the hospitalisation was treated conservatively. There were 4 (3.9%) minor procedural complications related to RFCA. Details are provided in Table 4.

Table 3. Quality of life (QoL) as assessed by the AFEQT questionnaire according to the documented recurrent atrial fibrillation or atrial tachycardias (AF/AT) during the first 12 months

	None recurrent AF/AT *n* = 137	Recurrent AF/AT *n* = 78	*P*
Symptoms (percent points)	92.1 ± 12.3	87.1 ± 15.7	**0.010**
Daily activities (percent points)	80.0 ± 20.2	72.4 ± 23.4	**0.013**
Treatment concerns (percent points)	90.5 ± 14.3	85.5 ± 17.5	**0.024**
Treatment satisfaction (percent points)	85.7 ± 18.6	81.2 ± 19.7	0.096
Global (percent points)	86.2 ± 14.0	80.2 ± 16.8	**0.005**

Note: Patients from both randomised groups are included. The AFEQT scores were converted into percent points of QoL, *i.e.*, no symptoms corresponded to 100 points (the best, *i.e.*, 100% QoL), and most severe symptoms corresponded to 0 points (the worst, *i.e.*, 0% QoL).

Table 4. Complications of the catheter ablation procedure (Bulava et al., 2024)

Complications of the ablation procedure (*n* = 103)	*N*	%
Periprocedural complications*	**0**	**0**
Death	0	0
Pericardial tamponade requiring pericardiocentesis	0	0
Pericardial effusion not requiring pericardiocentesis	0	0
Stroke or transitory ischemic attack	0	0
Phrenic nerve injury	0	0
Atrioventricular block	0	0
Sinoatrial block	0	0
Haemorrhage requiring surgical intervention	0	0
Postprocedural major complications*	**2**	**1.9**
Death	0	0
Pericardial tamponade requiring pericardiocentesis	0	0
Pericardial effusion not requiring pericardiocentesis	0	0
Stroke or transitory ischemic attack	0	0
Phrenic nerve injury	0	0
Vagal nerve injury	0	0
Gastric motility disorder	0	0
Pericarditis	0	0
Atrioventricular block requiring PM implantation	0	0
Sinoatrial block requiring PM implantation	0	0
Haemorrhage requiring surgical intervention	0	0
Symptomatic pulmonary vein stenosis	0	0
Haematuria prolonging hospitalisation	1	1.0
Femoral artery pseudoaneurysm requiring intervention	1	1.0
Postprocedural minor complications*	**4**	**3.9**
Small arteriovenous fistula at groin **	1	1.0
Groin hematoma not requiring intervention	3	2.9

Note: Two patients from the Hybrid Group withdrew their informed consent, three died before the scheduled procedure, and seven refused to undergo the electrophysiology mapping and ablation procedure. Data are provided for the remaining 103 patients. PM, permanent pacemaker. * There was not more than one documented event per patient. ** Resolved after manual compression.

Most patients (95.3% in the Hybrid Group and 93.6% in the Surgery Group) reported at least one of the symptoms during the last year before the index procedure. At 12 months, however, only 61 patients out of 78 patients (78.2%) who had recurrent AF/AT reported feeling the arrhythmia-related symptoms ($P < 0.001$). This proportion was not different between the Hybrid and Surgery Groups (14 out of 20 patients (70%) vs 47 out of 58 patients (81%), $P = 0.303$).

Discussion

In this multicentre, randomised controlled trial in structural heart disease patients with non-paroxysmal AF, we found that a hybrid ablation strategy for AF, *i.e.*, catheter ablation performed three months after concomitant CryoMaze, was safe and resulted in a higher overall QoL, mainly driven by symptom reduction, decreased treatment concerns, and improved treatment satisfaction.

More than a quarter of patients amenable to cardiac surgery suffer from AF (McCarthy et al., 2020), and current evidence-based recommendations strongly support surgical ablation in patients with AF undergoing cardiac surgery for other indications (Calkins et al., 2018; January et al., 2014). A hybrid ablation strategy seems better at reducing arrhythmia burden than repeated RFCA (Doll et al., 2023) and surgical-only ablation (Bulava et al., 2015; DeLurgio et al., 2020). Apart from the proven efficacy of hybrid ablations, we knew very little about the impact of hybrid ablations on the QoL of patients undergoing concomitant AF treatment as a part of another cardiac surgery procedure, nor did we know the magnitude of such an effect, if any.

Numerous non-pharmacological approaches in the AF treatment improved QoL, mainly in non-randomized settings, including direct current cardioversion (Berry et al., 2001), MAZE procedures (Lönnerholm 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 (for instance, an average increase of 20–40 points in the SF-36 scale, which has a maximum of 100 points) (Šafaříková and Bulava, 2021). However, the situation for hybrid ablation patients is different. In sequential hybrid concomitant AF ablation, the second procedural step, *i.e.*, RFCA, is needed, and the patient is informed about both procedures as part of the clinical deci-

sion to undergo complex AF treatment. Since QoL indices are subjective and multifactorial, the differences between the two types of ablation treatments could affect patients' personal perceptions, expectations, and fears. Second, patients undergoing concomitant AF procedures usually represent a cohort with significant cardiac and even non-cardiac comorbidities. Therefore, the magnitude of the effect of concomitant (or hybrid) AF treatment on QoL improvement had to be clarified in this specific patient population as patients' QoL improves on the account of cardiac surgery itself, which fixes the primary cardiac disease.

In our study exploring concomitant AF ablation, we demonstrated significant (on average 23 to 24 per cent points) improvement of global QoL. On top of that, we could show a significant (albeit numerically small) difference in QoL assessment between the CryoMaze alone and the hybrid treatment strategy. The difference varied between 4 to 9 percent points across the AFEQT QoL domains, with the most prominent effects on treatment satisfaction. One can speculate whether such a relatively modest QoL improvement represents a clinically relevant issue. Some studies advocated that the true "minimal important improvement" is difficult to define but is very likely to be somewhere between 6 and 19 percent points (Dorian et al., 2013). However, these estimates originate from the studies using baseline (pre-operative) and follow-up values, not directly comparing two treatment strategies. It is well-known that improving already high QoL by any treatment procedure may be extremely difficult. As the global QoL already exceeded 80 percent points in the Surgery Group, adding the RFCA procedure in the Hybrid Group was challenging in further improving QoL. Yet, the net benefit reached up to 9 per cent points. Thus, concerning the patients' baseline values and comorbidities, such an improvement may be, in our opinion, considered clinically meaningful, especially when we consider that patients in the Hybrid Group had to undergo one more invasive procedure requiring new hospitalisation that may cause deterioration of their QoL. However, despite this inconvenience, the QoL improved compared to patients in the Surgery Group treated conservatively after the surgery. Notably, this finding also highlights that the contemporary RFCA of AF is exceptionally safe and well-tolerated by patients. Therefore, catheter ablation, as a part of the hybrid procedure, seems to have a negligible contribution to typical risks otherwise associated with cardiac surgery accompanied by the concomitant CryoMaze and did not affect QoL scores.

The main reason that explains the difference in QoL between the patients allocated to the Hybrid Group and the Surgery Group is the reduction of arrhythmia recurrence, as shown in our primary publication: after hybrid ablation, we observed a 62% reduction in AF recurrence (HR = 0.38, 95% CI: 0.26–0.57, $P < 0.001$) (Bulava et al., 2024). This explanation is strongly supported by the fact that irrespective of patient allocation in the treatment or control group, global QoL and three of four AFEQT domains (symptoms, daily activities, and treatment concerns) were positively affected by the absence of AF/AT recurrence. Moreover, the AF burden was also reduced considerably in the Hybrid Group during the first 12 months post-procedure (median 0.0%, IQR: 0.0–0.9% vs median 0.25%, IQR: 0.0–4.1%, $P = 0.005$) (Bulava et al., 2024). Thus, arrhythmia recurrence seems to be the most significant denominator of the QoL after concomitant AF surgery, and subsequent RFCA procedure does not hamper the QoL but, on the contrary, favours its improvement.

However, there are trial limitations that need to be addressed. First, data presented in this study are exploratory and were not appropriately powered to detect differences between the study groups as a primary endpoint. Nonetheless, no such data were available until our study has been carried out. Hence, the results of the SURHYB Trial may be used for planning future studies focused on the QoL in patients after concomitant AF ablation. Second, QoL measurements should always be interpreted with caution. One needs to be aware that some episodes of AF are rendered asymptomatic following invasive treatment (Hindricks et al., 2005). Similarly, in our study, approximately 22% of patients did not report any symptoms at 12-month follow-up despite documented arrhythmia. However, the magnitude of converting symptomatic AF into asymptomatic AF was comparable between our study's Surgery and Hybrid Groups. Third, planning an invasive procedure may make patients expect their health conditions to 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). Sham procedures were not implemented in our trial due to ethical and organisational concerns. Still, we meticulously ensured that the patients were unaware of their randomisation when completing their baseline QoL assessment. They also remained blinded to the objective monitoring results before completing the questionnaires at the 12-month follow-up. Although we cannot wholly exclude the "treatment effect" nor entirely ignore the impact of the "Hawthorne effect", we believe their influence on our study result is unlikely, as the follow-up scheme and extent of medical care paid to both study and control group patients was precisely the same, apart from the RFCA procedure, which preceded the final QoL assessment by 12 months. Lastly, we used the rescoring of commonly used AFEQT questionnaires in our study. The primary rationale was to provide a straightforward interpretation for readers unfamiliar with the exact AFEQT scoring, including non-healthcare professionals. We assume that the QoL assessed on a scale from 0 to 100 percent points would be easy to understand, contrary to presenting an absolute sum of points acquired in the questionnaire (for instance, 20 and 140 absolute points representing the best QoL and the worst QoL in AFEQT, respectively). Thus, rescoring of AFEQT to percent points is commonly used in various clinical studies (Dorian et al., 2013) and more recently in different patients' mobile apps for a comparable treatment effect.

Conclusion

In a cohort of patients with persistent or long-standing persistent AF undergoing cardiac surgery for structural heart disease, catheter ablation performed sequentially after the CryoMaze procedure resulted in a higher QoL compared to CryoMaze alone. This was achieved with minimal risk of procedure-related complications. Arrhythmia recurrence was the most significant denominator of the QoL after concomitant AF surgery.

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Ethical aspects and conflict of interest
The authors of the manuscript have nothing to disclose.

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