Catheter-based cryoablation of atrial fibrillation: state of the art

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Catheter-based ablation has been adopted as second-line therapy for both paroxysmal and persistent atrial fibrillation (AF) and is currently investigated as a primary approach. Reported success rates of catheter-based radiofrequency (RF) ablation vary between 65% and 85% depending on the technique used, patient selection and experience of the center. However, catheter ablation of AF is not without risk. In a worldwide survey major complications were reported in up to 6% of the procedures. Also, in high volume centers a complication rate of 5% is reported, which declined after excluding the learning curve during the first 100 procedures to 4.3%. These complications and the observation that AF-ablation using RF-energy is a demanding procedure in terms of operator competency and dexterity limiting the world-wide availability of this therapy lead to an extensive search for alternative energy and delivery sources. In four studies from Europe the new cryoballoon approach is effective and safe and appears to have a similar success rate than RF-ablation at least in paroxysmal AF and normally sized left atria. Changes in catheter design and additional equipment will probably improve this technique. Further clinical studies should focus on a head-to-head comparison between cryoablation and RF-ablation in AF. The favourable risk profile of cryoenergy might pave the way for cryoballoon ablation as a first-line treatment option in patients with paroxysmal AF.

Key words: **Cryosurgery - Atrial fibrillation - Catheter ablation.**

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Atrial fibrillation (AF) is the most common acquired sustained supraventricular arrhythmia affecting 6% of patients older than 65 years of age and even 10% of the patients older than 80 years of age.

Do we need alternative energy and delivery sources for AF-ablation?

AF is characterized by uncoordinated atrial activation and consequently deteriorated atrial mechanical function. By electrocardiogram (ECG) AF is identified by rapid and oscillatory waves that vary in amplitude, shape and timing instead of regular P-waves.[1] Focal activity, multiple microreentrant wavelets and macroreentry modulated by the autonomic nervous system are all involved in initiation and perpetuation of AF.[1] AF can be initiated by ectopic beats originating from the pulmonary veins (PV) as recently shown by Haissaguerre *et al.*[2] However, other initiators of AF such as macroreentrant loops and multiple re-entrant wavelets meandering throughout the atria have well been described.[3, 4] Aware of this pathophysiology catheter-based ablation approaches have been developed focusing primarily on electrical disconnection of the pulmonary veins from the left atrium and secondarily on compartmentalization of the left atrial area available for reentry.[2, 5] Increasingly, catheter-based ablation has been adopted as second-line therapy for both paroxysmal and persistent atrial fibrillation and is currently investigated as a primary approach.[1] Reported success rates of catheter-based radiofrequency (RF) ablation vary between 65% and 85% depending on the technique used, patient selection and experience of the center.[6]

However, catheter ablation of AF is not without risk. In a worldwide survey major complications were reported in up to 6% of the procedures.[7] Also, in high volume centers a complication rate of 5% is reported, which declined after excluding the learning curve during the first 100 procedures to 4.3%.[8] Older patients >70 years and female patients appear to be prone to complications.[8] Reported complications may arise as a result of direct injury to cardiac structures, thermal injury to adjacent extracardiac structures by RF energy or thrombembolism. Since power used for RF-ablation has been reduced the incidence of cardiac tamponade has declined to currently ~1%.[6] Permanent or transient injury of the phrenic nerve is seen in ~0.5% of the patients.[6] Due to themal injury to the periesophageal vagal plexus gastric hypomotility with mostly transient symptomatic gastroparesis is seen ~1% of the patients.[6] Although electrophysiologists learned to avoid application of RF-energy in the pulmonary veins the rate of exposure of pulmonary veins to RF-energy the rate of pulmonary vein stenoses is still reported with a rate of ~1%.[6] Thrombus formation on ablated atrial tissue and char formation may lead to systemic thrombembolism in ~1% of the patients.[6] Finally, a very rare but life threatening complication is the formation of atrioesopageal fistula with a reported incidence of 0.05%.[6, 9]

These complications and the observation that AF-ablation using RF-energy is a demanding procedure in terms of operator competency and dexterity limiting the world-wide availability of this therapy lead to an extensive search for alternative energy and delivery sources. At present, cryoenergy is a promising technique on the way to make AF-ablation safe and simple. In the following review we give an overview of the biological characteristics of cryoenergy, the latest developments for applying cryoenergy in the left atrium, the first results of this new approach and future perspectives for cryoenergy in AF ablation.

What is the biological effect of cryoenergy on myocardium?

The injury evoked by cryoenergy is mainly due to two mechanisms: first the direct effect of freezing on cardiomyocytes and second the effect on cryoenergy on tissue vasculature.[10] The latter leads to expansion of necrosis during thawing, since microcirculatory failure during thawing leads to ischemia and consequent tissue damage.[10] The direct cell injury begins and progresses at temperatures below 0 °C. When temperature falls, ice crystals initially form in the extracellular space.[10, 11] These ice crystals draw water from within the cells, consequently cells loose volume, are damaged and may die.[10, 11] This hyperosmotic effect alone may be enough to damage cells irreversibly.[10, 11] However, when cryoenergy is applied over a longer duration ice crystals also form within the cells, which directly destroy membranes of important organelles and thus lead to cell death.[10, 11]

Shortly after tissue cooling vasoconstriction occurs and blood flow decreases, which even ceases upon ongoing freezing.[12-14] During thawing, circulation recovers. However, due to hyperemia and reactive vasodilation congestion of the tissue appears. Further endothelial leakage and capillary permeability aggravate tissue congestion and lead to circulatory stasis.[12-14]

Both effects of cryoenergy add to the formation of the typical cryogenic lesion which is a circumscribed coagulative necrosis in its central portion surrounded by a penumbra of only partially damaged tissue. Dependent on temperature achieved and size of the tip of the ablation catheter this lesion is about 3-4 mm deep. A fast cooling rate and a slow

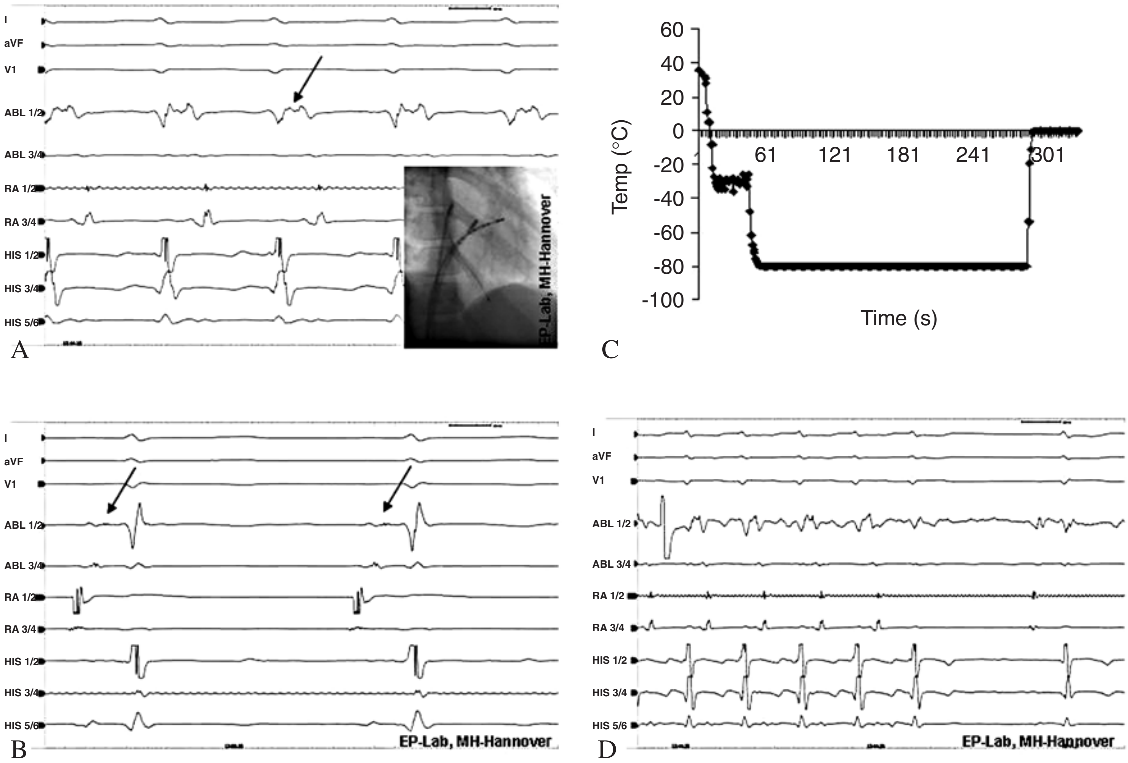


Figure 1.—A) Atrioventricular tachycardia in an 8-year-old girl with shortest VA-interval (arrow) and earliest retrograde A (arrow) at the parahisain region, see inset: RAO projection of catheter position: quadripolar catheter in high rate atrium and hexapolar catheter at the His and ablation catheter (Freezor Xtra, CryoCath, Montreal, QC, Canada) at the earliest retrograde A above His; B) signals during sinus rhythm and reveals prominent His-Signal on the ablation catheter (arrow); C) temperature curve for the Freezor Xtra Catheter, capable of cryo safety- and efficacy mapping. During the first 30 s the catheter achieves a temperature of only -30 °C for reversible cryolesion. When target can be successfully ablated and AV-conduction is preserved the ablation catheter is cooled down to -80°C to perform an irreversible cryolesion; D) termination of atrioventricular tachycardia 5s after starting cryomapping, AV-conduction is preserved.

thawing rate is advised to achieve an optimum lesion volume. Since in a second cycle tissue cooling is faster, ice crystals grow larger and thus a greater lesion depth is achievable repetitive freeze-thaw cycles are recommended.[15] For cardiomyocytes it has been shown that they loose contractile function but remain viable during temperatures of -1 to -2 °C. This unique characteristic of cryoenergy is preferably used in cardiac ablation of substrates near the AV-node.[16] During temperatures of -30 °C the operator can observe if the substrate can sufficiently been modified without irreversibly damaging the AV-node, because in case of AV-block thawing will lead to complete recovery of AV-conduction.[16] This technique is called safety- and efficacy mapping. One example of cryosafety- and efficacy mapping from our department is shown in Figure 1 in an 8-years old girl with a parahisian concealed accessory pathway.

Lesions created by cryoenergy are different from lesions created by RF-energy. Cryoablation lesions appear sharply defined and typically free of endothelial damage and surface thrombosis in contrast to RF lesions, where this is a common phenomenon.[17] Lesions created by a 4-mm-tip temperature-controlled RF-catheter are equal in depth compared with cryoablation with -75 °C and 4 minutes freezing, but RF lesions show larger cross sectional area.[18-20] The latter might be due to the fact, that the RF catheter is not stable during ablation within the beating heart, leading to "brushing", whereas the cyroablation catheter sticks to the wall due to ice crystal formation and cannot move on the endocardial surface. We have recently shown that ablation of typical flutter with a 4mm-irrigated-tip-RF-catheter resulted in a significantly reduced amount of CK/CKMB and Troponin release compared with cryoablation indicating that cryoenergy lesions might at least be as deep as RF–lesions when applied long enough.[21] This study also showed that use of cryoenergy was associated with significantly reduced inflammation as assessed by serum C-reactive protein levels 24 hours after cavotricuspid isthmus ablation.[21] In contrast to RF- energy cryoenergy preserves the collagen architecture which is used as a scaffold for repair. One further advantage which might also be due to the lower amount of scarring in the healing process of the cryolesion is the lack of pulmonary vein stenoses even when ablation is performed deeply in the vein or other vascular structures, *i.e.* coronary sinus.[22, 23] These are only few potential biological advantages of cryoenergy compared with RF energy and are most promising to reduce complications in AF ablation, particularly the risk for thrombembolism, PV stenosis and the risk for formation of atrioesophageal fistula.

Catheter-based cryoablation of AF: technique, success rate and safety

Currently the cryoballoon approach is the most attractive technique for cryoablation of AF. Briefly, via a deflectable 12-French transseptal sheath (FlexCath, CryoCath Technologies Inc., Montreal, QC, Canada) a deflectable, over-the-wire catheter with an inner and an outer balloon is inserted. Two balloon sizes are available (23mm and 28mm; Artic Front, CryoCath Technologies Inc., Montreal, QC, Canada) to allow for anatomic variance. After positioning the guidewire in the distal part of a pulmonary vein, the deflated balloon catheter is advanced to the PV ostium. Using the central balloon marker balloon position in the vein can be estimated before inflation. Once positioned the balloon is inflated. Pressurized liquid N_2O is delivered to the catheter tip via an ultrafine injection tube down a central lumen in the inner balloon, which works like an expansion chamber. By sudden expansion of the liquid gas it evaporates and absorbs heat from the adjacent tissue and low temperatures are achvieved up to -80 °C according to the Joule-Thomson effect. To ensure good balloon PV antrum contact an occlusion PV-angiography is performed via the central lumen of the catheter (Figure 2). If optimum pulmonary venous occlusion is achieved cryoablation is started for at least 5 min. Usually temperatures of -50 °C to -60 °C are reached, which are higher than expected. This is due to the position of the thermocouple element which is located proximal to the balloon and thus measures temperature in the left atrium and at the surface the occluding balloon.

The most crucial issue of circumferential cryoablation is to achieve an optimum contact between balloon and PV antrum. We made the experience that choosing a balloon slightly larger than the vein is important. To our experience in most of the cases the 28 mm balloon is preferable. To show optimum contact a contrast injection in the vein showing absence of leak is inevitable. If balloon occlusion is not as good as desired various manoeuvres are possible including changing angulation and rotation of the sheath, changing angulation of the balloon catheter, retracting or pushing the balloon more to the antrum and finally changing guidewire position to another distal side branch of the PV which leads to improved balloon position in the antrum. At least two cryoablations is uasually performed for each vein to achieve a larger lesion size by repetitive freeze-thaw cycles as mentioned above. To choose the right balloon size and position of the balloon in the antrum the authors are convinced that PV-angiography before cryoballoon ablation is mandatory (Figure 3). Furthermore the authors recommend not to access left atrium via preexisting patent foramen ovale but instead to do trans-septal puncture as anterior as possible to gain flexibility for bal-

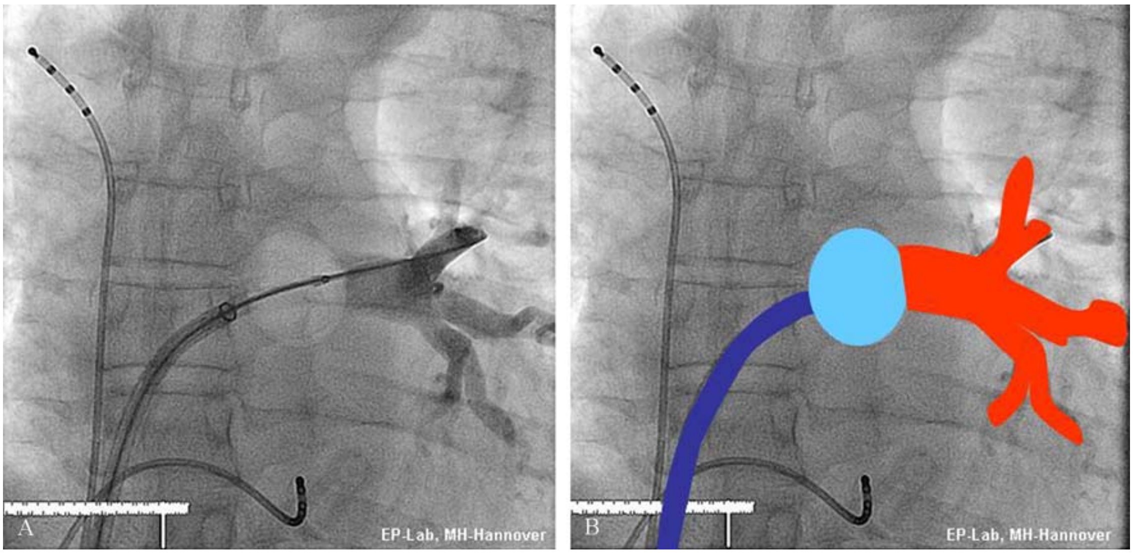


Figure 2.—A) PV-angiography via inflated cryoballoon catheter is shown with total occlusion of the left inferior pulmonary vein. Quadripolar catheter already in position at the superior vena cava to perform phrenic nerve stimulation for cryoablation of right superior pulmonary vein. Hexapolar catheter is positioned in the coronary sinus; B) Dark blue: flexable transseptal sheath, light blue: cryoballoon with optimum occlusion of the left inferior pulmonary vein (red).

loon position in the most difficult vein, the right inferior PV.

Precautions to prevent thrombembolism are the same than in RF ablation: the sheath is permanently flushed with a heparinised saline solution and activated clotting time is kept at 350s by repetitive measurements every 30 min. When retracting or inserting the balloon catheter or the Lasso catheter in the sheath we carefully aspirate the sheath to avoid air embolism.

Acute success rates of cryoballoon AF-ablation

Currently four groups have published their first results of the cryoballoon AF-ablation approach.[24-28] The cryoballoon AF-ablation technique was started 2 years ago in a very healthy AF patient population with paroxysmal AF and normally sized atria without structural heart disease apart from myocardial hypertrophy due to hypertension or non-significant coronary artery disease.[24] The 21 patients in the authors' prospective study had weekly episodes of AF and were already treated with at least 2 unsuccessful antiarrhythmics before scheduled ablation.[24] The mean total procedure time of ablation was 165±35 min, the fluoroscopy time was 39±6 min; 95% (81/85) of all veins could be isolated with a single balloon technique as carefully verified by Lasso catheter showing entrance and exitblock (Figure 4).[24] These results were confirmed by a large prospective German multicenter study including 346 patients with paroxysmal and persistent AF but without severe structural heart disease.[26] Left atria were slightly enlarged (42 mm in short axis view). Neumann *et al.* showed that mean total procedure time was similar to ours with 170 min, as was mean total fluoroscopy time with 40 min.[24, 26] The acute success rate as confirmed by Lasso-catheter mapping was lower than in the authors' study with 78% (1 294/1 403 veins) isolation of all veins with use of one or two balloons.[26] Overall, in 109 veins additional use of a steerable conventional cryoablation catheter (Freezor Max, CryoCath Technolo-gies Inc., Montreal, QC, Canada) was necessary to achieve a PV-isolation rate of 97%.[26] By trend a touch up with a conventional catheter was more often necessary in the right inferior vein.[26] Van Belle *et al.* recently presented their success rates of cryoballon AF-ablation in 57 patients with paroxysmal AF without structural heart disease and

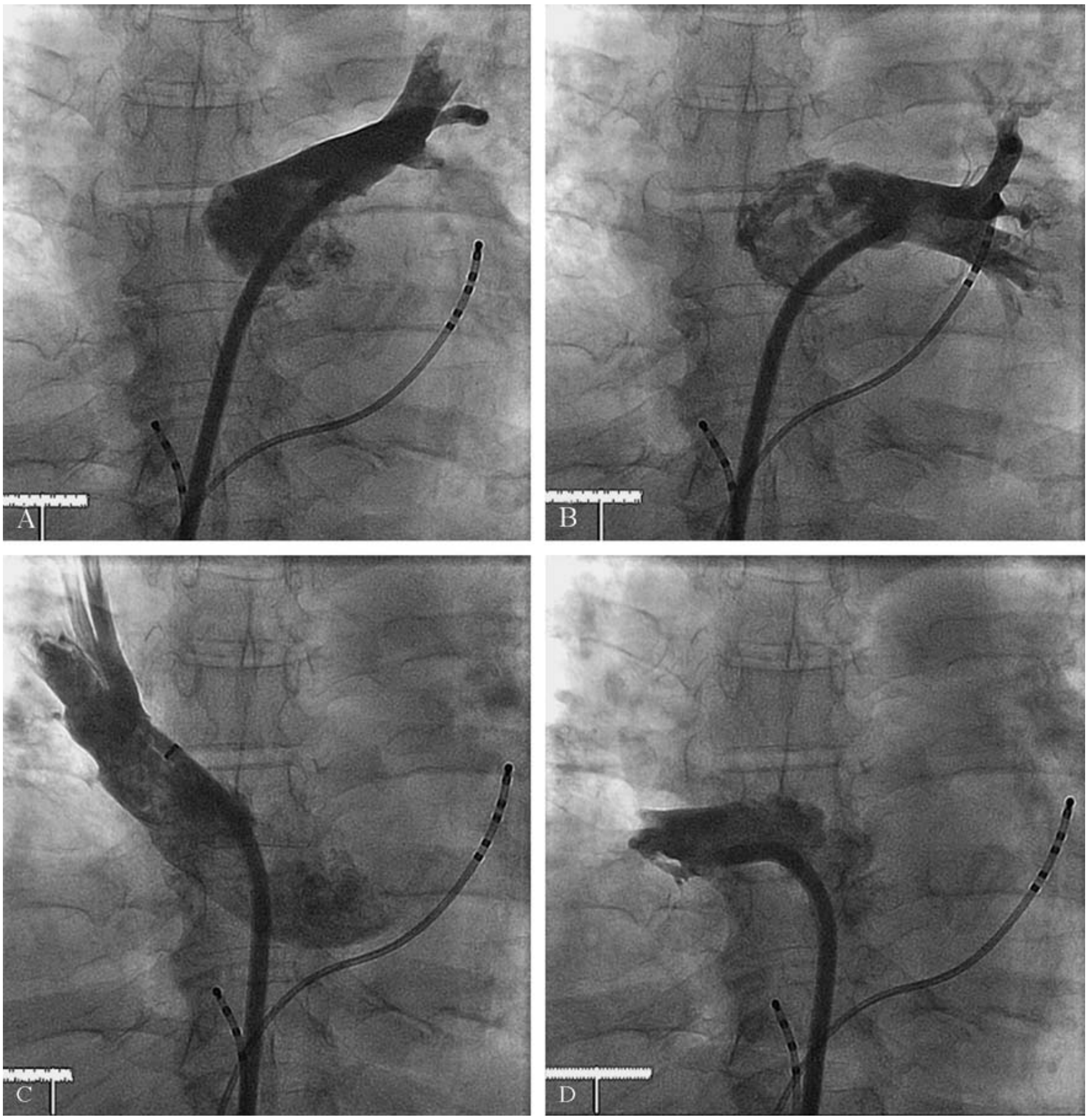
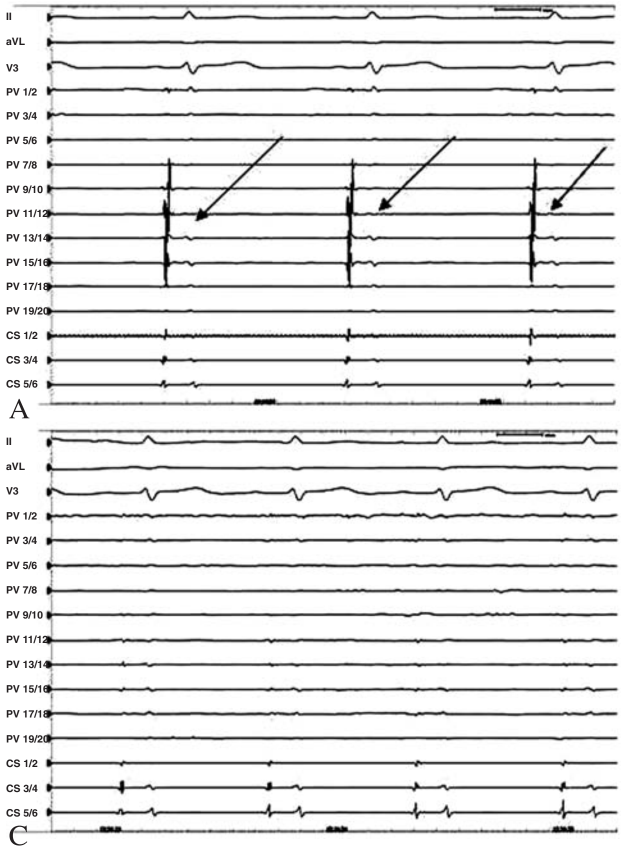


Figure 3.—PV angiography in a.p. projection of the 4 pulmonary veins via transseptal sheath cryo-balloon. A: left superior PV; B: left inferior PV; C: right superior PV; D: right inferior PV.

slightly enlarged left atria (43 mm in short axis view).[27] Their procedure time was much longer with 232±100 min and also fluoroscopy time was markedly longer with 58±35 min.[27] Acute success rate of PV isolation using the balloon was slightly lower achieving isolation in 185 of targeted 220 veins (84%).[27] The latest report about cryoballoon AF-ablation came from Sweden.[25] Malmborg *et al.* studied 40 patients with paroxysmal and persistent AF without severe structural heart disease and enlarged atria (44 mm in short axis view).[25] They needed a total procedure time of 239±48 min and a fluoroscopy time of 57±21 min and had an acute success rate of PV isolation with cryoballon only of 56%.[25] Procedure times and fluoroscopy times were different in the four



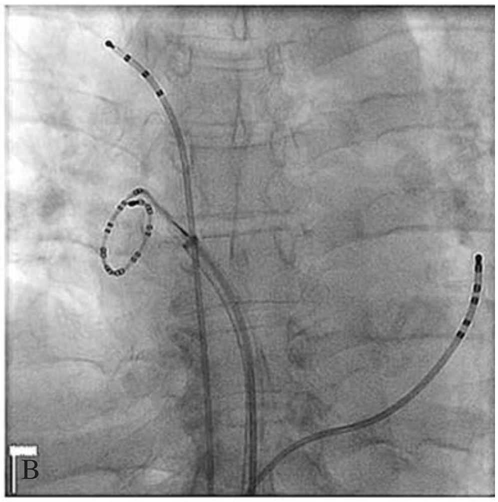


Figure 4.—A) Tracings show surface ECG in sinus rhythm and 10 intracardiac tracings from the dodecapolar Lasso-catheter (B) which is positioned inside the right superior pulmonary vein. Pulmonary vein potentials are marked with an arrow. The pulmonary vein potentials disappeared after successful cryoballoon ablation (C).

studies, higher in the Dutch and Swedish report and lower in the two German studies. Various reasons might explain the difference, but it might mainly be due to local agreements on when to use fluoroscopy, experience and technique of transseptal puncture and PV-angiography, experience in percutaneous coronary interventions, which might be helpful for this kind of approach and also preparation of the procedure which might finally influence the total procedure duration. The acute success rate of PV-isolation with only cryoballoon use was between 78% and 95%, but much lower in the Swedish study.[24-26, 28] However, in the Swedish study 15% of the patients had already one or two previous failed presumably RF-ablation procedures for AF and their patients appeared to have the largest left atria with a mean of 44 mm.[25] Furthermore the Swedish group did not routinely perform PV-angiography before choosing the balloon size, which we find is inevitable to achieve good cryoballoon ablation results.[25] Irrespec-tive of the exact acute success rates the first results show that an anatomical based ablation approach using a balloon system might be limited when anatomy is difficult or left atria are enlarged and even the largest balloon is too small and thus is only able to occlude the vein in the periphery and not as desired at the antrum.

Long-term success rates of cryoballoon AF-ablation

From the same groups as mentioned above long-term results after 6 and 12 months are available.[24-26, 28] Since the studies differ concerning their inclusion criteria and follow-up approach the results are not homogenous.

In the authors' study of 21 patients we had a 81% 6-months success rate without antiarrhythmic drugs (AAD), defined as free of symptomatic AF-episodes and free of AF in 3 24 h-Holter-ECG's at 4 weeks, 3 months and 6 months as well as free of AF-episodes documented by event recorder in symptomatic patients.[24] Neumann *et al.* performed quarterly follow-up visits with 7- days- Holter-ECG's.[26] They defined the first three months as blanking period and counted recurrences only after the first three months. After a median of 12 months 74% of the patients with paroxysmal AF were free of AF without AAD, whereas the patients with persistent AF had a significantly lower success rate of 42%. The Dutch group recently reported their long-term results showing that after 12 months of follow-up 73% of the patients were free of AF when the first three months were blanked as in the study by Neumann *et al.* and 59% were free of AF after 12 months without AAD's.[28] However, van Belle *et al.* performed event recording with daily transtelephonic 30s ECG-strips and 24 h-Holter-ECG's only during or at the three months follow-up. Further 24 h-Holter-ECG's were at the discretion of the physician. Including AF-episodes of the event recorder monitoring in the analysis only 44% of the patients were free of AF-recurrence.[28] This clearly shows that evaluating success rates in AF-ablation mainly depend on how close we are looking for (asymptomatic) AF-episodes. In the Swedish study 53% of the patients were free from arrhythmia-related symptoms after 9 months, mainly without AAD.[25] In contrast to Neumann *et al.* the authors did not find a difference between persistent and paroxysmal AF in their small study.[25] The follow-up approach was the most superficial with only one 24h-Holter-ECG at 6 months or via mode-switch episodes in 3 patients who had a pacemaker.[25]

In the two larger studies, from Germany and the Netherlands, a multivariate regression analysis was performed regarding predictors of AF recurrence.[26, 28] Neumann *et al.* found that increased left atrial dimensions and persistent AF were independent predictors of recurrence whereas van Belle *et al.* found early recurrences of AF during the first three months as assessed by event recorder highly predictive for recurrence after three months.[26, 28] This result strongly argues against the widely used current practice of ignoring early recurrences during the first three months. Interestingly, van Belle *et al.* also reported about their re-do procedures and found that in those 24 patients, who underwent a second procedure there was a reconduction of an average of 3 veins.[28] Highest rates of reconduction were found in the left superior and inferior veins, lowest in the right inferior veins. 54% of the patients who had a second procedure were free of AF after 7.5 months on average.[28] In our study also two patients had recurrence of AF, who underwent a second left atrial mapping.[24] Both showed persistence of PV-isolation. However, one patient was previously isolated with a 23 mm balloon. To achieve more substrate modification we performed a second ablation with a 28 mm balloon despite isolated veins and the patient is now free of AF for 12 months without AAD.[29]

Summarizing the long-term results of the first cryoballoon AF-ablation studies the results appear to be quite similar to those of RF-ablation, achieving success rates of 53% to 81% after 6-12 months.[24-26, 28] The difference in success rates might be mainly due to differences in follow-up and patient selection. Further multicenter, prospective and randomized studies with a strict and accurate ECG-follow-up, preferably by close 7days-Holter-ECGs, are needed for direct comparison of RF-ablation and cryoablation in patients with paroxysmal AF.

Complications of cryoballoon AF-ablation

The complication rates of all 4 studies are summarized in Table I. It is quite clear from these data, that the risk of thrombembolism and pulmonary vein stenosis is low with cryoenergy and at least as low, if not lower than in RF-ablation, considering the fact, that all studies reporting about cryoballoon ablation did not exclude their individual learning curve.[24-26, 28] Taking the 4 studies together in 548 patients treated with the cryoballoon no stroke and no PV-stenosis, no atrioesophageal

TABLE I.—*Reported safety of cryoballoon ablation of AF.*

	Klein *et al.*[24] N.=21	Neumann *et al.*[26] N.=346	van Belle *et al.*[28] N.=141	Maimborg *et al.*[25] N.=40
Thrombembolism	-	-	-	-
PV-stenosis	-	-	-	-
Atrial tachycardia	-	-	-	-
Atrioesophageal fistula	-	-	-	-
Right phrenic nerve palsy	14% (3)	7.5% (26)	2.8% (4)	4.7% (2)
Pericardial effusion	-	0.6% (2)	5.6% (8)	2.5% (1)

fistula and no cryoablation related atrial tachycardia was detected.[24-26, 28] The risk for pericardial effusion seems to be quite similar to RF-ablation varying between 0% and 5.6% of the patients. This complication is frequently not detected if no routine assessment is performed shortly after the procedure and 24 hours later as we do. Since the routine regarding assessment of pericardial effusion is not reported in most of the studies, it remains speculation, if there are differences between cryoenergy and RF-ablation. The rate of pericardial tamponade is low in all studies varying between 0.5-0.7%.[24, 26, 28] One rupture of a left superior pulmonary vein has been reported by inflating the balloon in the periphery of the vein.[28] To the authors' experience this complication can be avoided by performing PV-angiography before ablation and taking care of the position of the central balloon marker compared with a freeze image of the venous angiography. Peripheral balloon inflation should not occur using this approach.

One complication has been reported by all 4 groups, the right phrenic nerve palsy.[24-26, 28] In our study three patients had a right phrenic nerve palsy, only one was symptomatic.[24] Two were observed using a 28 mm and one using a 23 mm sized balloon.[24] After 12 months all palsies completely resolved.[24] Two of the palsies occurred during the first 6 procedures and might have been avoided by a more atrial position of the balloon. In this respect we did not observe the size of the balloon to be relevant because one palsy occurred with a 23 mm sized balloon and the two others occurred with a 28 mm balloon. The authors consider that independent of balloon size a balloon position deep in the vein should be avoided. We routinely perform right phrenic nerve capture via pacing in the superior vena cava and stop ablation in case of non-capture. If pace mapping using electroanatomic mapping is helpful in this respect is unclear and it is unlikely that this will establish in cryoballoon ablation, since this approach was developed to perform without any electroanatomical mapping.[30] In all other studies from Germany, the Netherlands and Sweden, also all phrenic nerve palsies recovered during the following 12 months.[25, 26, 28] Phrenic nerve palsy is not a complication unique to cryoablation or to the cryoballoon technique, but has also been described by radiofrequency and ultrasound ablation, but balloon approaches might be more vulnerable to this complication, probably by stretching the nerve and leading to a compression of the nerve.[6, 31, 32] In contrast to RF-ablation, where only approximately two thirds of the palsies are expected to completely recover, the phrenic nerve palsy after cryoablation seems to be reversible.[32] The rate of phrenic nerve palsies appears to be higher in the two German studies which might be explained by the fact that during the early days of cryoballoon ablation this complication was not as widely known as it is now. The lower number of phrenic nerve palsies in the Swedish study who were already aware of this problem, might indicate that phrenic nerve palsy was a frequent complication of the pioneer groups and might be preventable in the majority of the cases by simply being aware of this problem. A similar decreasing trend has also been shown for PV stenosis after the first reports about venous thrombosis and stenosis following RF-ablation of AF.[6]

Future perspectives of cryoenergy in AF-ablation

Cryoballoon ablation of AF is an anatomical based approach and therefore is limited in cases with difficult anatomy. This could be avoided by a preablation magnetic resonance imaging (MRI)- or computed tomography (CT)-scan and in case of anatomic difficulties, *i.e.* common ostia patient could be scheduled for RF-ablation. However, the limited current experience of cryoballoon ablation does not allow to prospectively decide which vein will be difficult to ablate according to the preablation imaging.

To the authors' experience sometimes a larger balloon would be helpful at least in patients with enlarged left atria and large left or right superior veins to achieve an optimum of atrial substrate modification. However larger balloons also will have disadvantages regarding isolation of the right inferior veins, which are more difficult to isolate with a balloon approach due to their proximity to the transseptal puncture site. In this respect compliant balloons instead of a non-compliant balloon would improve the handling. Another possibility to achieve more atrial substrate modification could be a set of cryoballoons without over-the-wire technique that could be positioned and pressed close to the roof, the posterior atrial wall and the septal wall. To even shorten procedure time a wire with characteristics of decapolar Lasso catheter which can be advanced through the cryoballoon into the vein would be helpful to always directly realise the acute success of each cryoablation.

Conclusions

Cryoballoon AF-ablation has been shown to be an effective and safe procedure and appears to have a similar success rate than RF-ablation at least in paroxysmal AF and normally sized left atria. Changes in catheter design and additional equipment will probably improve this technique. Further clinical studies should focus on a head-to-head comparison between cryoablation and RF-ablation in AF. The favourable risk profile of cryoenergy might pave the way for cryoballoon ablation as a first-line treatment option in patients with paroxysmal AF.

Riassunto

Crioablazione con catetere della fibrillazione atriale: stato dell'arte

L'ablazione con catetere è stata adottata come terapia di seconda linea per la fibrillazione atriale (FA) parossistica e persistente ed è attualmente studiata come un approccio primario. I tassi di successo riportati per l'ablazione con catetere mediante radiofrequenza (RF) variano fra 65% e 85% a seconda della tecnica utilizzata, la selezione dei pazienti e l'esperienza del centro. Tuttavia, l'ablazione con catetere della FA non è priva di rischio. A livello mondiale, il tasso di complicanze maggiori associate a queste procedure raggiunge il 6%. Inoltre, nei centri con elevate casistiche, il tasso di complicanze è pari al 5%, che dopo l'esclusione della fase di apprendimento relativa alle prime 100 procedure scende al 4,3%. Queste complicanze e il fatto che l'ablazione della FA utilizzando le RF risulti essere una procedura impegnativa in termini di competenza e abilità dell'operatore, hanno limitato la diffusione a livello mondiale di questa terapia, una ricerca estesa di alternative energetiche e di fonti di applicazione. In 4 studi europei, un nuovo approccio con criopallone è risultato efficace e sicuro, oltre che dotato di un simile tasso di successo rispetto all'ablazione con RF, almeno nella FA parossistica e in presenza di atrio sinistro normale. Ulteriori modifiche nel design dei cateteri e ulteriori dispositivi potranno probabilmente migliorare questa tecnica. Nuovi studi clinici dovrebbero eseguire un confronto testa a testa fra crioablazione e ablazione con RF nella FA. Il favorevole profilo di rischio della crioenergia può aprire la strada all'uso dell'ablazione con criopallone quale opzione terapeutica di prima linea nei pazienti con FA parossistica.

Parole chiave: Chirurgia crio-ablativa - Fibrillazione atriale - Ablazione transcatetere.

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