Cryoballoon versus radiofrequency catheter ablation for atrial fibrillation: insights from the Netherlands Heart Registration (2013-2021)

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Background: Cryoballoon ablation has emerged as a viable alternative to radiofrequency (RF) ablation in the treatment of atrial fibrillation (AF) with catheter ablation. Randomized trials and observational studies have demonstrated no statistically significant difference in the overall safety, efficacy, and effectiveness of RF and cryoballoon technologies. Despite over a decade of cryoballoon ablation use, there is limited population-level data comparing uptake in the utilization, populations referred, complications, and rates of repeat ablation of cryoballoon versus RF ablation.

Purpose: Our objective was to compare the real-world temporal trends in the utilization and complication rates of cryoballoon versus RF ablation for AF in the Netherlands between 2013 and 2021.

Methods: The Netherlands Heart Registration was used for the present study and included all consecutive patients who underwent AF ablation at 16 hospitals in the Netherlands (2013-2021). Only patients who underwent RF or cryoballoon ablation were included. Crude, age-, and sex-standardized annual incidence rates for AF ablation were calculated. Incidence rate ratios (IRR) and temporal trends were assessed with Poisson regression models with robust variances. Multivariable logistic regressions were used to compare the incidence complications between ablation methods.

Results: Of 37,538 AF ablations performed in the Netherlands, 20,799 (55.4%) and 12,549 (33.4%) underwent RF and cryoballoon ablations, respectively. At index AF ablation, patients referred to cryoballoon ablation were more likely women (34.3% vs 31.9%) and more frequently treated for paroxysmal AF (76.8% vs 68.0%) compared to RF patients [cryoballoon vs RF, respectively; p<0.05 for both]. Age of patients did not differ between ablation methods [median age for both: 63 (IQR 56-69) years; p=0.9]. From 2013 to 2021, the utilization of cryoballoon ablation increased by 16% for index ablations (p<0.05; Figure 1). Further, the population-level incidence of cryoballoon ablation was similar to RF ablation for index ablations from 2016 onwards (Figure 1). Repeat ablations (n=10,511) were primarily performed with RF (91.5%). Patients with cryoballoon ablation had a reduced risk of referral for repeat ablation [aHR 0.7 (95% CI 0.6-0.7)]. After multivariable adjustment, cryoballoon ablation was a risk factor for phrenic nerve paralysis [aOR 18.6 (95% CI 9.5-36.4)] and RF was a risk factor for cardiac tamponade [aOR 2.7 (95% CI 1.7-4.3)] and minor vascular complications [aOR 1.4 (95% CI 1.1-1.8)] for index ablation. No difference was detected for the incidence of other complications between ablation methods (Figure 2). Incidence of all complications remained stable over time (p>0.05 for both).

Conclusion: The utilization of cryoballoon and RF ablation has rapidly increased from 2013 to 2021 in the Netherlands. Further, cryoballoon was used as frequently as RF ablations for index AF ablation procedures from 2016 onwards.
Figure 1. Annual incidence rates for RF and cryoballoon AF ablation

- IRR_{RF (All)}: 1.10 (95% CI: 1.08-1.13)
- IRR_{RF (Index)}: 1.15 (95% CI: 1.10-1.20)
- IRR_{Cryo (All)}: 1.07 (95% CI: 1.06-1.09)
- IRR_{Cryo (Index)}: 1.16 (95% CI: 1.11-1.21)

Year of AF Ablation

*AF, atrial fibrillation; IRR, incidence rate ratio; RF, radiofrequency ablation.

Figure 2. Incidence of complications in RF and cryoballoon index AF ablation

- Proportion of Patients
  - Bleeding (in hospital): p=0.58
  - Phrenic paralysis (in hospital): p=0.51
  - Thrombosis (72-hours): p=0.0001
  - Cardiac tamponade (30-days): p=0.28
  - Major vascular complications (30-days): p=0.046
  - Minor vascular complications (30-days): p=0.06
  - Mortality (30-days): p=0.06

*AF, atrial fibrillation; RF, radiofrequency ablation.