Hemoptysis After Cryoablation for Atrial Fibrillation
Truth or Just a Myth?

To the Editor:

Cryoballoon is a novel tool for a pulmonary vein (PV) isolation, having unique advantages compared with conventional radiofrequency catheter ablation. 1 Complications of cryoenergy ablation may be due to damage of structures close to the application site, resulting in phrenic nerve paralysis, gastroparesis, atrioesophageal fistula, or esophageal lesions as collateral cryoablation damage. 2 Until now, a few authors reported on hemoptysis after cryoballoon ablation but without regular follow-up or a definite etiology. Cryoablation causes vascular injury through multiple factors, including ice formation within the vasculature. The ice during expansion causes the formation of tears, clefts, leakages, and stases postreperfusion. 3 The interruption of vascular integrity is the reason for intramyocardial hemorrhage as well as for hemoptysis associated with cryoinjury to the lung tissue. A few reports on the effects of freezing have described acute lung injury due to cytokine release in about 35% of animal subjects. 4

Previously, we summarized the relationship of cryoablation with hemoptysis with evidence ranging from several animal studies traced back to 1974 5 and later clinical evidence. 6 This motivated us to retrospectively collect data on such patients at Maastricht University Medical Center and to attempt to paint a clearer picture.

![Figure 1](image-url) - Time course of hemoptysis in six patients. Hemoptysis occurred during the procedure in patient 2. For patients 1 and 5, hemoptysis started the day after the procedure (d 1) and continued for 2 and 7 d, respectively. For patient 1, acenocoumarol was immediately stopped on the day of hemoptysis and restarted 7 d after the procedure. In patient 5, oral anticoagulation was not interrupted. Hemoptysis developed in patient 3, continuing for 7 d after the 3 days of cryoablation. Acenocoumarol was interrupted only 5 d after the ablation for 7 d and replaced by LMWH. Patient 4 presented the next day after the ablation due to hemoptysis; on the same day, acenocoumarol was interrupted but restarted the next day. Hemoptysis developed in the last patient on d 5 after pulmonary vein ablation and continued for the next 2 d. D = day postprocedure; LMWH = low-molecular-weight heparin; PV1 = pulmonary vein isolation.
Hemoptysis occurred in six of 283 patients (200 men; age, 58 ± 10 years) who underwent PV isolation for symptomatic atrial fibrillation (Fig 1, Table 1). To investigate the etiology of hemoptysis, a chest radiograph, contrast-enhanced multidetector-row CT scan of the thorax, and bronchoscopy were performed with a 1-year follow-up. A random control group of 20 patients with similar clinical characteristics was selected to compare the procedural parameters that may predict the etiology of hemoptysis. Right-sided diaphragmatic paralysis was observed in two of five patients undergoing chest radiography. CT scans did not reveal any PV stenosis but did show ground glass opacification in the right inferior PV of five subjects and in the right superior PV of two patients presenting with hemoptysis. The intensity of ground glass opacification is also related to the temporal delay of CT scan. Further, right superior PVs showed ostial in duration in two patients. Hyperemic mucosa and erosion were discovered using bronchoscopy in two patients. The statistical analysis revealed lower temperature of the right inferior PV (26°C) compared with that of the control group (25°C, P = .025) and deeper positioning of a smaller cryoballoon among patients with hemoptysis. Thus, hemoptysis is an uncommon side effect associated with cryoballoon ablation for atrial fibrillation in 2.1% of patients and attributable to lower temperature and deeper positioning during cryoblation.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age, y</th>
<th>Sex</th>
<th>Balloon Size, mm</th>
<th>LSPV</th>
<th>LIPV</th>
<th>RSPV</th>
<th>RIPV</th>
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<td>53</td>
<td>M</td>
<td>28</td>
<td>21</td>
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<td>−75, −45</td>
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<td>−62, −65</td>
<td>18</td>
<td>−56, −58</td>
</tr>
</tbody>
</table>

One number indicates one application; two numbers indicate two applications. D = diameter; F = female; LIPV = left inferior pulmonary vein; LSPV = left superior pulmonary vein; M = male; RIPV = right inferior pulmonary vein; RSPV = right superior pulmonary vein; T = minimum temperature during a cryoballoon application of the pulmonary vein.

**TABLE 1** Procedural Parameters of the Six Patients With Hemoptysis

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References


