Steam Pop During Radiofrequency Ablation: Imaging Features on Magnetic Resonance Imaging and Multidetector Computed Tomography

Hubert Cochet, MD, PhD; Frederic Sacher, MD; Arnaud Chaumeil, MD; Pierre Jais, MD

A 48-year-old woman was referred to catheter ablation for symptomatic premature ventricular contraction (PVC). Left ventricular endocardial mapping was performed via a retrograde aortic approach using a 3-dimensional electroanatomic mapping system (Carto3; Biosense Webster, Diamond Bar, CA). PVCs were only present during exertion. No PVC was present at baseline. Isoproterenol infusion was started and initiated PVCs when heart rate was ≈100 beats per minute. PVC origin was identified at the inferoseptal region mainly based on pacemapping. Radiofrequency ablation was performed using a 3.5-mm open-irrigation catheter that enables contact force monitoring (Smartouch; Biosense Webster). On a midventricular site (site 1), radiofrequency was delivered for 2 minutes (35 W; contact force, 20g) resulting in successful termination of the ectopic. Unfortunately, isoproterenol infusion unmasked a second morphology close to the previous one, possibly because of a change of exit site. After a combination of pacemapping and activation mapping, a more basal site was targeted (site 2). Radiofrequency was delivered for 74 seconds at the power of 40 W with a mean contact force of 35g and was interrupted due to a steam pop. The patient remained asymptomatic, and no pericardial effusion was seen on immediate 2-dimensional echocardiography. No more PVC was seen 30 minutes after ablation despite isoproterenol infusion.

On day 1, MRI was performed on a 1.5-Tesla scanner (Avanto; Siemens Medical Systems, Erlangen, Germany). T2-weighted imaging showed a large area of myocardial edema extending in the whole septum, beyond ablation sites (Figure, A). Delayed-enhanced imaging was performed at high spatial resolution (1.25×1.25×2.5 mm) using a free breathing method initially developed for atrial imaging. Both ablation sites exhibited a peripheral enhancement surrounding a no-reflow-like dark core, suggesting myocardial and microvascular necrosis (Figure, B). No difference was observed between the sites with or without steam pop. Cine imaging showed myocardial swelling on site 1 (without steam pop; Movie 1 in Data Supplement). On site 2 (with steam pop), an intramyocardial bright area was seen on the inferior septum at end-systole, communicating with left ventricular blood pool (Movie II in the Data Supplement). ECG-gated, contrast-enhanced, multidetector computed tomography was performed on a 64-slice scanner (Somatom Definition; Siemens Medical Systems, Forchheim, Germany). On site 1 (without steam pop), myocardial hypodensity was seen, suggesting either myocardial edema or tissue necrosis. On site 2 (with steam pop), an area of intense enhancement communicating with intraventricular blood pool was seen, surrounded by myocardial hypodensity. This pattern suggested that steam pop had induced an intramyocardial hematoma communicating with ventricular cavity. Myocardial swelling was seen on both ablation sites. None of the ablation lesions was transmural. Transmurality of lesions with and without steam pop was similar, indicating that steam pop had only damaged subendocardial myocardial layers.

Steam pop refers to the audible sound produced by intramyocardial explosion when tissue temperature reaches 100°C, leading to the production of gas. It is a potentially severe complication of radiofrequency ablation because it has been associated with cardiac perforation and ventricular septal defect. The present case is, to our knowledge, the first to report on imaging features of a steam pop lesion on MRI and computed tomography. The site of steam pop appears as an intramyocardial hematoma communicating with ventricular cavity. However, it does not translate into increased lesion transmurality. Additional studies are required to define the potential role of systematic imaging after steam pop.

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Disclosures
None.
References


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Figure. Imaging features on day 1 after steam pop. T2-weighted MRI in short axis shows diffuse septal edema extending beyond ablation sites (A). Late-gadolinium enhancement in transaxial plane shows a peripheral enhancement surrounding a no-reflow-like dark core on both ablation sites (with or without steam pop; B). ECG-gated, contrast-enhanced, multidetector computed tomography shows myocardial hypodensity on site 1 (without steam pop; C and D). On site 2 (with steam pop), an area of intense enhancement communicating with intraventricular blood pool is seen, surrounded by myocardial hypodensity (C and E). This pattern suggests that steam pop has induced an intramyocardial hematoma communicating with ventricular cavity. Myocardial swelling is seen on both ablation sites. None of the ablation lesions is transmural. Transmurality of lesions with and without steam pop is similar, indicating that steam pop has only damaged subendocardial myocardial layers.
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