Cryoballoon ablation has become a standard treatment in the management of atrial fibrillation (AF). The ovality index (OI) of the pulmonary veins (PVs) is one of the factors that may affect the efficiency of cryoballoon ablation. It is defined as a ratio of the maximum to the minimum diameter of the PV ostium. Veins are usually classified as circular (OI < 1.2), oval (OI, 1.2–1.4), or flat (OI > 1.4).

We report a case of a 53-year-old man with persistent AF and extremely flat PVs (mean OI, 1.675) who was referred to our department for PV isolation.

Preprocedural computed tomography revealed a typical configuration of 4 PVs with the following diameters (longitudinal × transverse): left superior PV (LSPV), 22 × 10 mm; left inferior PV (LIPV), 22 × 13 mm; right superior PV (RSPV), 27 × 18 mm; and right inferior PV (RIPV), 23 × 18 mm (Figure 1A and 1B). Furthermore, it showed left atrial volume of 250 ml, the cauliflower-like left atrial appendage, and normal coronary arteries. On transthoracic echocardiography, left ventricular ejection fraction was 52%, and the left atrial diameter, 36 mm.

Cryoballoon PV isolation was conducted under conscious sedation. After a single transseptal puncture (with the BRK-1XS needle [Abbott, St. Paul, Minnesota, United States]) performed under fluoroscopic guidance, a 28-mm cryoballoon (AF Advance ST, Medtronic, Minneapolis, Minnesota, United States) was introduced into the left atrium using a steerable sheath (FlexCath, Medtronic). The occlusion of each vein was confirmed after contrast injection (Figure 1C–1F). Remarkably, due to proper occlusion, the ostia were altered to a more circular shape (compliant with the cryoballoon), which was more prominent in the right veins compared with the left ones (25% vs 10.2%).

The application sequence was LSPV–LIPV–RSPV–RIPV. A single cryoapplication (180 s) was delivered to isolate each vein. The temperature nadir was –49 ºC at 151 s of freeze in the LSPV (OI, 2.2), –48 ºC at 134 s in the LIPV (OI, 1.7), –45 ºC at 155 s in the RSPV (OI, 1.5), and –54 ºC at 146 s in the RIPV (OI, 1.3). In order to avoid phrenic nerve palsy, diaphragmatic stimulation from the right subclavian vein was performed during right-sided cryoapplications. Considering the high OI, a dedicated guidewire (PV-tracker, Medtronic) advanced to the distal part of the vein was used for the cryoballoon positioning to obtain optimal stability. Consequently, bidirectional electrical isolation in all PVs was confirmed with a decapolar mapping catheter (Inquiry, Abbott, Minneapolis, Minnesota, United States).

Typically, left PVs have higher OI compared with the right ones, which was observed in our case. A high OI impedes adequate vein occlusion and may lead to worse short- and long-term outcomes. This relationship was clearly defined for the LSPV. More oval PVs are associated with frequent AF recurrence. In our patient, the PVs (except for the RIPV) were extremely flat, but we achieved good occlusion and adequate
temperatures, which was confirmed with bidirectional isolation after a single 180-second cryoapplication in each vein. After 3-month follow-up, the patient remains free of arrhythmia.

Our case shows that PVs with a high OI can be effectively isolated with a third-generation cryoballoon catheter.