CASE REPORT

Electroanatomical mapping and radiofrequency ablation of an accessory pathway associated with a large aneurysm of the coronary sinus

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Abstract
We report a case of a patient with a left posteroseptal accessory pathway associated with a coronary sinus (CS) aneurysm. The patient had undergone two previous failed ablation attempts at other institutions despite multiple radiofrequency applications delivered within and outside the CS aneurysm. Electroanatomical mapping was performed and allowed delineation of the three-dimensional anatomy of the aneurysm, so as to identify the ventricular insertion site, and to permit successful ablation of the pathway without any complications.

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Introduction

In recent years it has been recognized, in a number of pathological and clinical studies, that posteroseptal accessory pathways may be associated in some cases with coronary sinus (CS) aneurysms otherwise known as diverticula [1–5]. In a recent comprehensive article it was postulated that the ventricular end of these accessory pathways is formed by a connection between the CS myocardial sheath and the epicardial surface of the ventricle [5]. These unique pathways may account for some of the failures experienced in the past during radiofrequency (RF) ablation procedures of posteroseptal and left posterior pathways [3–7]. We report a case of an accessory pathway in a CS aneurysm, where two previous attempts had failed to ablate the pathway despite multiple RF applications within the aneurysm. Electroanatomical mapping was used to delineate the three-dimensional geometry of the aneurysm, to identify
the ventricular insertion site, and successfully to ablate the accessory pathway without any complications. To our knowledge, this is the first report of electroanatomical mapping and ablation of a CS aneurysm-associated accessory pathway.

Case report

A 34-year-old male patient was referred to our service after two failed attempts at radiofrequency ablation of a posteroseptal accessory pathway performed in a different hospital. This patient suffered from recurrent palpitations for 6 months prior to admission. The surface ECG in sinus rhythm (Fig. 1) showed preexcitation with a negative delta wave in II, III, and aVF and a transition zone between V1 and V2. During the two previous electrophysiological studies, an orthodromic as well as what seemed to be antidromic accessory pathway mediated tachycardias were easily induced. A coronary sinus aneurysm was found at these studies but despite multiple RF applications at apparently suitable sites within the pouch, the arrhythmia could not be terminated.

In the current study an orthodromic but not an antidromic accessory pathway mediated tachycardia was easily induced. Coronary sinus angiography, performed by a catheter through the femoral vein, revealed a large CS aneurysm near the coronary sinus ostium (Fig. 2). The aneurysm had a bilobar (“hourglass”) appearance with a narrow connection between the two lobes. Both antegrade and retrograde conduction were found via the pathway.

A 7F locatable Navistar catheter (Biosense-Webster, Diamond Bay, CA) was introduced to the right atrium and detailed electroanatomical mapping of the CS and the associated aneurysm was performed using the Carto system (Biosense-Webster). The relatively large dimensions of the aneurysm allowed the easy navigation of the Carto catheter (which may be a little stiffer than conventional ablation catheters) to desired sites. The resulting electroanatomical map revealed a large CS aneurysm with the largest diameter being 4.7 cm (Fig. 3).

The earliest ventricular activation during sinus rhythm (red area) was located at the septal aspect of the inferior part of the divertculum and preceded the delta wave by 51 ms (Fig. 3, right). The unipolar and bipolar intracardiac electrograms recorded at this site can be viewed in Fig. 3, right panel. A single RF application (marked as a brown tag in the map in Fig. 3) delivered at this site, in a temperature controlled mode (60 °C) and

Figure 1  Twelve lead surface ECG during sinus rhythm showing preexcitation with a negative delta wave in II, III, aVF and a transition zone between V1 and V2.
**Figure 2** Coronary sinus angiograms shown from the right anterior oblique (left panel), anteroposterior (middle panel), and left anterior oblique (right panel) views. Note the presence of a large bilobar CS aneurysm with a relatively narrow connection between the two lobes.

**Figure 3** The corresponding electroanatomical maps performed during sinus rhythm shown from an anteroposterior (left panel) and right anterior oblique (middle panel) views. The gray area depicts the CS body while the rest of the map delineates the large aneurysm. Successful radiofrequency ablation (brown tag) was performed at the earliest ventricular activation (red area). The unipolar and bipolar electrograms recorded at the successful ablation site by the roving catheter are depicted in the right panel. Note the fusion of the local CS aneurysm-related potential with the earliest ventricular electrogram. The timing of the local ventricular activation time at the successful ablation site preceded the onset of the QRS in lead V6 by 51 ms.
a maximum power setting of 40 W, terminated conduction via the accessory pathway (Fig. 4). Following ablation, the tachycardia could not be induced and conduction through the pathway could not be demonstrated both antegradely and retrogradely also following pharmacological challenges with isoprenaline and adenosine. There were no procedure related complications and the patient remained well and asymptomatic during two years of follow up without any evidence of a delta wave in repeated electrocardiograms.

**Discussion**

In recent years it has been demonstrated that CS aneurysms can be associated with posteroseptal and left posterior accessory pathways [1–6] and rarely can even masquerade as left posterolateral pathways [7]. It is believed that abnormal embryological development of the sinus venosus is the cause of CS aneurysms and that the accessory pathway is a remnant of the muscle sheath that surrounds the proximal CS [8].

The majority of CS aneurysms are located along the inferoseptal aspect of the CS (usually within 1.5 cm of the CS ostium including 25% of the cases in which the aneurysm extends from the medial cardiac vein rather than from the CS itself) and the rest further along the left inferior portion of the CS [5]. The aneurysm connects with the CS by either a narrow, intermediate, or broad neck [5]. The prevalence of CS aneurysms in patients with left posteroseptal accessory pathways varies in the literature from 2% to 26% [4–6]. In the largest series reported, Sun et al. [5] have found aneurysms in 7.5% (36 out of 480) of these patients but in only 2% of patients presenting for a first ablation (rather than for a repeat procedure). These data suggest that the CS aneurysm-associated pathways may account for many of the previous failed ablations of left posteroseptal pathways.

In the current case, two previous attempts had failed to ablate the posteroseptal accessory pathway despite multiple RF applications given at apparently appropriate sites within and outside the aneurysm. We, therefore, chose to use the Carto system for this procedure although theoretically, since this pathway was shown eventually to have a single ventricular insertion site, the conventional approach could also have succeeded.

Electroanatomical mapping within the CS aneurysm delineated its geometry and depicted the earliest ventricular site using the "hot—cold" approach at the lowest portion (4—5 cm beneath the CS ostium) of the inferoseptal aspect of the aneurysm. The local electrogram at this site was characterized by fusion of the CS diverticular potential with the earliest ventricular activation, supports the hypothesis that the ventricular end of these accessory pathways consist of muscle fibres extending through the aneurysm to bridge the epicardial portion of the ventricle to
the CS musculature. This very low ventricular insertion site may also be one of the reasons for the absence of a deep S wave in lead V6 during sinus rhythm in this patient. The presence of such deep S waves together with a positive steep delta wave in aVR was found to be a relatively specific (but relatively non-sensitive) indicator for the need to ablate posteroseptal pathways within the CS or within the middle cardiac veins [10]. The atrial ends of these aneurysm-associated accessory pathways are usually formed by connection of the CS muscular sheath to the right and left atria which sometimes may extend up to 50 mm along to the CS [7,9].

Conclusion

This case illustrates the value of CS angiography in patients with posteroseptal accessory pathways and the important contribution of electroanatomical mapping [11] in outlining the three-dimensional anatomy of the aneurysm and facilitating successful ablation. Electroanatomical mapping may be of even greater value in cases with even more complex CS anomalies and also in cases with multiple accessory pathway insertion sites.

References


