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Silent Cerebral Infarcts Following Left-Sided Accessory Pathway Ablation in Wolff-Parkinson-White (WPW) Syndrome: A Preliminary Report

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Background: Catheter ablation is a routine procedure in patients with WPW syndrome. Silent cerebral infarcts (SCI) detected in magnetic resonance imaging may be a complication of the ablation procedure, but it is well documented only in atrial fibrillation ablation. Ablation of left-sided accessory pathways (L-AP) has a similar target area, but WPW patients differ from those with atrial fibrillation, due to lower initial risk of cerebral embolic events. The aim of this study was to determine whether the ablation of left-sided accessory pathways carries the risk of SCI.





Material/Methods: Twenty consecutive patients with overt L-AP referred for RF ablation in our center were included in the study. An irrigated ablation catheter was used in 8 patients, and a non-irrigated ablation catheter was used in 12 patients. Diffusion-weighted magnetic resonance imaging was performed pre-procedurally and on the next day after the ablation in all patients.

Results: Ablation procedures were completed without complications and there were no neurological symptoms following the procedure, although in 2 patients (10%), post-procedural diffusion-weighted magnetic resonance revealed new acute silent cerebral infarcts. Both patients with new cerebral lesions were female, and a non-irrigated catheter was used in both cases.

Conclusions: This is the first study documenting the presence of silent cerebral infarcts after WPW ablation. Further investigations are needed to evaluate the risk of silent cerebral infarcts associated with L-AP ablation.

MeSH Keywords: **Catheter Ablation • Stroke • Wolff-Parkinson-White Syndrome**

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Background

Cerebral ischemia and stroke are possible complications of the ablation procedure, especially in patients with atrial fibrillation (AF). In the vast majority of patients, periprocedural cerebral embolism is completely asymptomatic and can be detected with diffusion-weighted magnetic resonance imaging (DW-MRI), a useful tool to detect acute cerebral ischemic lesions [1]. This phenomenon is usually referred to as silent cerebral infarct (SCI), and is well documented in AF ablation, with an incidence of 1.7–43%, depending upon procedural parameters and technology used [2–5]. Recently, it was also reported after left-sided ventricular arrhythmias ablation [6]. The clinical significance of SCI is being discussed, and there are data linking this phenomenon with cognitive disorders and dementia [7,8]. The relatively high incidence of SCI during AF ablation can be explained by the high risk of cerebral embolic events in the AF population itself. Atrial fibrillation increases the risk of stroke 5-fold, and the risk of death 2-fold [9–11]. Additionally, the specific target area for curative ablation in AF, localized in the left atrium, makes it more likely that any procedure-related thromboembolic material will easily travel with the blood flow to the central nervous system, resulting in (symptomatic or not) ischemic lesions.

In the population of patients with Wolf-Parkinson-White syndrome (WPW), the accessory pathway is more frequently localized in the left heart (between the left atrium and the left ventricle) [12]. In this subgroup of WPW patients, during the ablation procedure we target the same area as during the AF ablation, but the patients are different from those with AF, with low initial risk of cerebral embolic events. The described incidence of symptomatic cerebral stroke complicating the ablation in WPW syndrome is low [13]. Interestingly, the presence of microembolic signals detected by transcranial Doppler during left-sided accessory pathway ablation was recently described [14], but there are no published data on the incidence of MRI-confirmed silent cerebral infarcts related to this procedure.

The purpose of this study was to determine whether the ablation of left-sided accessory pathways carries the same risk of silent cerebral infarcts as in AF ablation.

Material and Methods

Patients characteristics

Twenty consecutive WPW patients (white, 13 males, mean age 44.9 ± 14.7 years) with overt left-sided accessory pathway, without structural heart disease, referred for radiofrequency (RF) ablation in our center were included in the study. Patients with current contraindications for MRI were excluded. The characteristics of

Table 1. Characteristics of the patients.

Age – years	44.9±14.7
Female sex no. (%)	7 (35%)
CHF	2 (10%)
Hypertension	8 (40%)
Diabetes	1 (5%)
Previous stroke	0 (0%)
Vascular disease	2 (10%)
Smoking	2 (10%)
CHA ₂ DS ₂ -VASc score	1.1±1.0
eGFR	85.1±14.5

Plus-minus values are means \pm SD. CHF – congestive heart failure

the patients are presented in Table 1. No patients had a history of cerebrovascular incident or transient ischemic attack or evidence of aortic atherosclerotic disease. We decided to calculate the CHA₂DS₂-VASc score (although none of the patients had the history of atrial fibrillation), as it involves the same known risk factors for stroke as in the non-AF population. Eight patients (40%) had a history of arterial hypertension. Two patients received aspirin, which was continued during the procedure.

Study protocol

In all patients, neurological assessment and DW-MRI were performed on the day before the ablation procedure. The same examination, including DW-MRI, was repeated on the day after the ablation procedure in all patients. The study protocol was approved by the Bioethical Committee of the Medical University of Lublin (approval number KE-0254/292/2012) and written informed consent was signed by all participants.

Accessory pathway ablation

Radiofrequency (RF) catheter ablation of left-sided accessory pathway was successfully performed in all 20 patients with no acute complications, with a mean procedure time of 92.7 ± 23.6 minutes. To reach the ablation site, in 13 patients we used the retrograde approach via the femoral artery, and in 7 patients we used the transseptal approach. Irrigated-tip ablation catheters (Thermocool, Biosense Webster or ALCath Flux, Biotronic) were used in 12 patients (Table 2), and in 8 patients we used solid-tip ablation catheters (Marinir, Medtronic, or ALCath, Biotronic). The operator decided which ablation catheter type to use. In all patients, a diagnostic decapolar catheter was placed in the coronary sinus. Heparin (total dose of 75 I.U. per kg body weight) was administered during the procedure: half of the dose at the beginning of the procedure and

Table 2. Procedural characteristics.

Procedure time	92.7±23.6
Fluoroscopy time	11.4±5.0
Transseptal approach	7 (35%)
Non-irrigated catheter	12 (60%)
INR ratio	1.02±0.08
APTT	29.1±3.3

Plus-minus values are means ±SD.

the other half immediately after catheters were introduced to the left heart (both with retrograde or transseptal approach). In case of transseptal approach, the transseptal sheath was constantly flushed with heparinized saline. Radiofrequency energy (Atakr II RF generator, Medtronic) was delivered in power-control mode (power limit 30 W, maximum temperature 46°C) with an irrigated-tip catheter, and with temperature-control mode (power limit 50 W, maximum temperature 60°C) it was delivered with a solid-tip catheter. All patients received enoxaparin (1 mg/kg) at 6 and 24 h after the procedure, followed by acetylsalicylic acid for 6 weeks.

Diffusion-weighted MRI

Magnetic resonance imaging (1.5 Tesla Siemens Avanto) was performed the day before and within 48 h after the ablation procedure in all patients. The protocol included a diffusion-weighted single-shot spin echo sequence (diffusion gradient b values of 0 and 1.000 s/mm² repetition time 4000 ms, echo time 89 ms, slice thickness 5 mm), fluid-attenuated inversion recovery (FLAIR; TR/TE 9.000/120 msec), and T2-weighted turbo spin echo (TSE; TR/TE 4.000/99 ms) sequences. Acute ischemic lesions were defined as focal diffusion anomalies – “bright signals”. Additionally, apparent diffusion coefficient (ADC) was measured to assist image analysis in equivocal cases. All MRIs were analyzed by a certified radiologist.

Results

Introduction of the catheters, accessory pathway mapping, and ablation were completed in all patients, without acute complications. There was no evidence of charring/clot formation on the ablation catheter, and no air embolism was detected during all ablation procedures. The mean procedure time was 92.7 min and mean fluoroscopy time was 11.4 min. There were no neurological symptoms following the procedure, although in 2 patients (10%), post-procedural diffusion-weighted magnetic resonance (DW+FLAIR) revealed new acute silent cerebral infarcts, as described below.

The first patient was a 49-year-old woman with the history of hypertension. She had no history of stroke or transient ischemic attack and her CHA₂DS₂-VASc score was 2. Transthoracic echocardiography was normal. Retrograde approach to the ablation site was used and the ablation was performed with an 8-mm solid-tip catheter. The procedure time was 110 min. The post-procedural diffusion-weighted MRI revealed 2 new cerebral infarcts, located in the right parietal lobe and in the left cerebellar hemisphere (Figure 1A–1D).

The second patient was a 19-year-old woman without coexisting comorbidities, and her CHA₂DS₂-VASc score was 1. Transthoracic echocardiography was normal. Transseptal approach to the ablation site was used and the ablation was performed with an 8-mm solid-tip catheter. The procedure time was 120 min. The post-procedural diffusion-weighted MRI revealed a new embolic lesion in the left frontal lobe (Figure 2A, 2B). Clinical examinations performed on the same and the following day revealed no clinical signs of cerebral ischemia in either patient.

The study population was not large enough to identify the risk factors, but both patients with new cerebral lesions were females and, in both cases, a non-irrigated catheter was used.

Discussion

Main findings

To the best of our knowledge, this is the first study documenting the presence of acute silent cerebral infarcts detected by DW-MRI during the different approaches to the left-sided accessory pathway catheter ablation. The results show that SCI: (1) can occur with the use of both transseptal or retrograde approach and (2) were recorded only when ablation was performed with non-irrigated catheters.

DW-MRI for silent cerebral ischemia detection

DW-MRI is a useful diagnostic tool to detect silent cerebral lesions. Acute ischemia of brain tissue leads to severe restriction in diffusion of water, almost certainly due to cytotoxic edema, which is identified as “bright signals” on DW-MRI soon after ischemia onset [15]. With this tool, SCI was described after such potentially thrombogenic cardiovascular interventions as coronary angioplasty [16], cardiac surgery [17], carotid endarterectomy [18] transcatheter aortic valve implantation [19], and atrial fibrillation ablation [1–5]. In a recently published paper, Whitman et al. for the first time reported the presence of SCI detected with DW-MRI after ablation of arrhythmia other than atrial fibrillation. Interestingly, they documented the presence of asymptomatic cerebral infarcts after ablation of ventricular arrhythmias originating in the left but not in the right

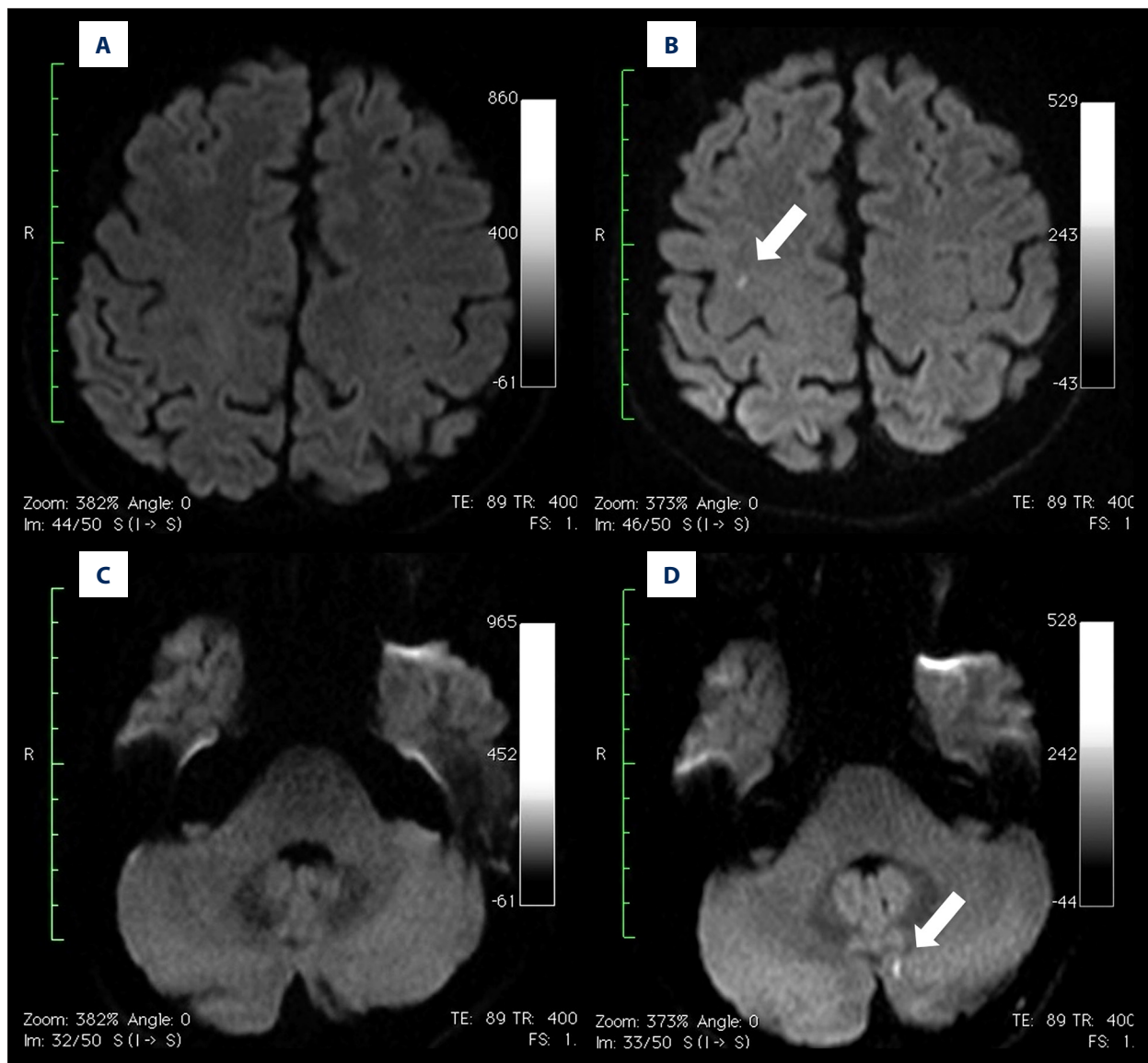


Figure 1. DW-MRI before (A, C) and after (B, D) the ablation procedure, demonstrating new ischemic lesions in the right parietal lobe (C) and in the left cerebellar hemisphere (D) in the first patient.

ventricle [6]. To date, there are no such data concerning accessory pathway ablation.

Possible risk factors of SCI

There are several identified risk factors of SCI following AF ablation: age [20], spontaneous echocardiographic contrast in TEE examination [21,22], and cardioversion during the ablation procedure [2]. In our study, both patients with new post-procedural silent cerebral infarcts were females and in both a non-irrigated solid-tip catheter was used. Although women in general have slightly higher risk of thromboembolic events (reflected in the CHA₂DS₂-VASc score calculation), published reports [2,6,21,22] show no correlation between sex

and the incidence of silent cerebral infarcts following ablation procedures.

To the best of our knowledge, there are no data on SCI incidence following ablation procedure with non-irrigated solid-tip standard catheter, since it is no longer used in the atrial fibrillation ablation. There are published reports regarding SCI after AF ablation with different types of non-irrigated catheters dedicated to the pulmonary vein isolation: cryoballoon, laser balloon, and multipolar phased radiofrequency catheters [3–5,22]; however, these technologies are entirely different from classical catheters. The standard, solid-tip catheters are commonly used during accessory pathway ablation in WPW patients, and our study is the first to demonstrate the incidence of SCI following such procedures.

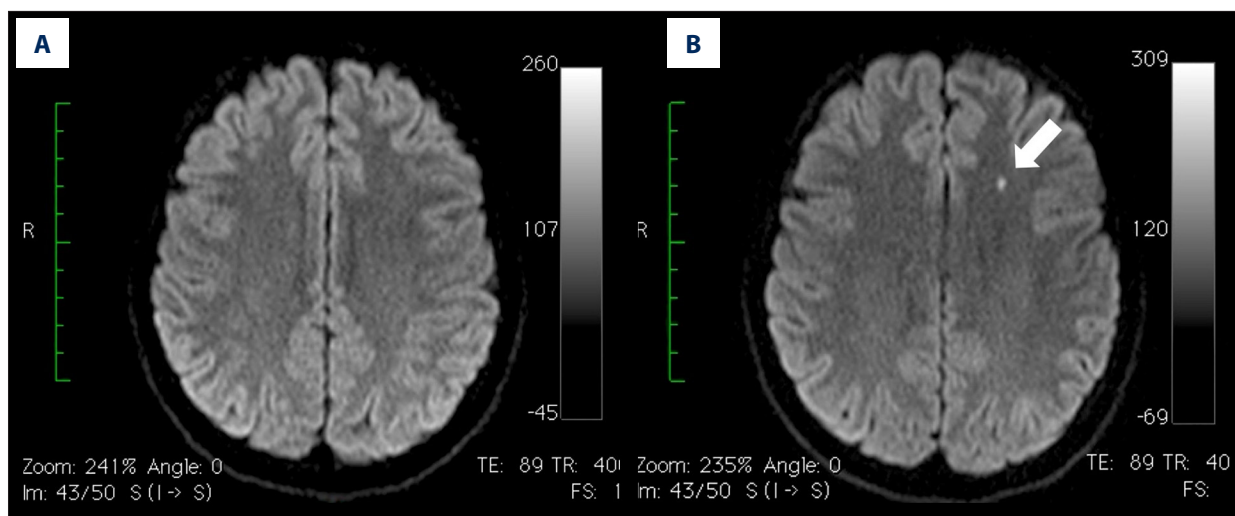


Figure 2. DW-MRI before (A) and after (B) the ablation procedure, demonstrating new ischemic lesion in the left frontal lobe in the second patient.

The clinical significance of SCI

Although SCI phenomenon related to various cardiovascular interventions was documented, we still do not know if it is really clinically significant. First, ischemic lesions detected by MRI are by definition symptomless, and in most of the cases the ischemic lesions are no longer detectable by DW-MRI performed several months after the index procedure [23]. Both of the above “known knowns” could lead us to conclude that SCI is an irrelevant finding. On the other hand, there is evidence that silent cerebral embolism is associated with dementia and gradual cognitive decline [7,8]. Moreover, silent cerebral infarcts can be considered as the marker of thrombogenicity of cardiovascular interventions. Fortunately, symptomatic stroke does not happen frequently enough during most cardiovascular invasive procedures to help us to determine its risk factors, except in very large cohorts. Thus, in studies involving smaller number of patients, SCE can serve as a stroke substitute, permitting the analysis of potential patient- and procedure-dependent risk factors. It is generally agreed that a lower incidence of silent cerebral lesions is associated with lower risk related to the procedure. When we compare our finding of 10% incidence of SCE during the left-sided accessory pathway ablation to the early report by Lickfett et al. [1], who also documented a 10% incidence of SCE related to AF ablation, as well as with the subsequently published data [2–5], the left-sided accessory pathway ablation probably has similar thrombogenicity to that of AF ablation. The far lower incidence of reported symptomatic strokes related to WPW ablation probably results from the fact that the patients with WPW syndrome are different from those with AF, with significantly lower initial risk of stroke [9,12].

This risk may be increased, however, in the group of WPW patients with coexisting paroxysmal AF, independent of the increased risk of life-threatening ventricular arrhythmias.

We demonstrated the presence of new silent cerebral infarcts after left-sided accessory pathway ablation. The study population was too small to provide adequate statistical power, but it is noteworthy that new ischemic lesions were recorded only after ablation procedures performed with non-irrigated catheters.

Study limitations

First, this was a preliminary study; therefore, the study population was not large enough to identify risk factors. Second, the activated clotting time was not monitored because of the short procedure time and the small number of radiofrequency applications.

Conclusions

This is the first study demonstrating the incidence of new silent cerebral infarcts detected by DW-MRI after left-sided accessory pathways ablation. The long-term consequences of these findings are still unknown, and further investigations are needed to evaluate the risk of silent cerebral infarcts associated with accessory pathway ablation.

Conflicts of interest

None.

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