



The 6-Year Single-Center Cardiac Electrophysiologic Study Experience on 1152 Patients for Cardiac Arrhythmia Adagnosis and Treatment

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Abstract

Objective: Cardiac electrophysiology study (EPS) is an invasive procedure performed for diagnosis and treatment of cardiac arrhythmias. The aim of our study was to assess our 6-year EPS experience and to compare our data with the complication rate published in the literature.

Methods: We included 1152 patients who were diagnosed and treated for cardiac arrhythmia in our hospital between 2000-2006. The demographic data of all patients with a presumptive diagnosis of arrhythmia, EPS indications, treatment procedures, and complications were recorded.

Results: Six hundred and seventy-three of 1152 (58%) patients enrolled in the study were males with a mean age of 49.6 years, and 479 (42%) were females with a mean age of 48 years. One hundred and fifty-six (13.5%) patients had bradyarrhythmia, 596 (51.8%) patients had supraventricular tachycardia, 400 (34.7%) had ventricular tachycardia. One patient had complete AV block, one patient had hemopericardium, one patient had pericardial tamponade, one patient had pneumothorax, one patient had right thrombophlebitis one patient had sheath fracture, and one patient died after left popliteal embolization. Total mortality rate was 0.6%.

Conclusion: The EPS performed in experienced centers with the same team for a long period of time results in low complication rate.

Keywords: Arrhythmia, electrophysiological study, cardiac complication

Introduction

Palpitation comprises approximately 20% of all cardiac complaints. Non-invasive tests are frequently used clinically to determine the reasons for these complaints (1). An electrophysiological study (EPS) is an invasive procedure to evaluate conduction pathways and stimulation focuses with electrical activity in the heart (2). With the popularity of EPS, cardiac arrhythmia management has drastically changed (3). EPS is the preferred process for the final diagnosis of the dysfunction of physiological stimulation centers and conduction pathways and for the detection of extra stimulation centers and conduction pathways. Furthermore, EPS has been successfully used with low complication rates, with technological support in experienced centers in invasive procedures such as the ablation of accessories stimulation points and conduction pathways, the application of permanent pacemaker and defibrillator, and cardiac resynchronization therapy (1, 2).

The aim of this study is to retrospectively investigate complications in 1152 patients who underwent diagnostic and treatment procedures for cardiac arrhythmia by an experienced single center and the same team between 2000 and 2006.

Methods

The patient files at İstanbul University Cardiology Institute were retrospectively evaluated by scanning the complications caused by diagnostic electrophysiology, catheter ablation, device implantation [intracardiac defibrillator (ICD), permanent pacemaker, and loop recorder], and radiofrequency (RF) for supraventricular and ventricular tachyarrhythmia. Ablation procedures were classified according to the arrhythmias stimulated by standard electrophysiological definitions and techniques. Patients with AV nodal reentrant tachycardia (AVNRT) (typical and atypical) independent of structural heart disease, AV reentrant tachycardia including latent or manifest accessory pathway, clockwise or anticlockwise right and left atrium originated atrial flutter, focal or macro reentrant atrial tachycardia, pulmonary vein isolation, and atrial fibrillation and ventricular tachycardia were included in the study.

Ablation procedures were performed using standard mapping and ablation techniques. In more than 99% of the cases, a 4-mm tipped RF energy ablation catheter was used. An 8-mm tipped catheter was used in most procedures related to atrial flutter. A power source with 50–60 Co heat

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provided the needed RF energy. RF energy was applied between 30 s and 2 min, and it was accompanied by continuous electrocardiography (ECG), intracardiac electrogram, and intermittent fluoroscopy.

All patients were taken to the catheterization laboratory after 12 h of fasting. Propofol, fentanyl, and midazolam were administered for sedation by an anesthesiologist while monitoring blood pressure, oxygen saturation, and ECG. Coronary sinus access was conducted through the left femoral vein pathway using a decapolar catheter routinely. Right ventricle and His catheters were used by the right femoral vein pathway. Detailed electrophysiological evaluation was performed using standard stimulation and recording techniques for establishing accurate diagnosis and performing ablation in the correct region. The routine retrograde aortic approach through the left femoral artery was used for left side originated accessory pathways. Access to the right-sided accessory pathway provided through the right femoral vein was performed using the anterior or posterior aspect of the left anterior oblique image. Slow pathway ablation in patients with AVNRT was often done using the right anterior oblique view. ICD or permanent pacemaker implantation was performed by left subclavian puncture using the left pectoral region. Prior to implantation, all patients were given routine intravenous cefazolin 2 g. After the procedure, chest X-ray and transthoracic echocardiography control were performed for all patients. All patients were monitored for 24 h after the procedure. They were evaluated by ECG before they were discharged. The study was approved by the local ethics committee. Because the study was designed for retrospectively evaluating patient files, consent from patients was not needed.

Complications and Monitoring

Patients were followed-up in an outpatient clinic and by telephone for 24 weeks after EPS or device implantation. Complications were divided into three groups according to the severity or permanence of the event:

1. Major or life-threatening complications: death, myocardial infarction, embolic stroke with transient or persistent neurologic symptoms, death, myocardial infarction, permanent cardiac conduction block (2nd or 3rd degree), major valve damage, or pulmonary embolism
2. Serious complications: deep vein thrombosis, pericardial effusion requiring drainage, pseudoaneurysm, disturbance of the lead following AV nodal ablation and transient cardiac conduction block
3. Minor complications: hematoma, pericardial effusion, and pericarditis without pericardial tamponade.

Statistical analysis

Results were presented with numerical data, and descriptive analyses were given in mean \pm SD.

Results

The study included 1152 patients who underwent EPS for the diagnosis and treatment of cardiac arrhythmia in Istanbul University Cardiology Institute between 2000 and 2006. The characteristics of the patients are summarized in Table 1. The mean age of the

patients included in the study (\pm SD) was 49 \pm 16 years (age range 10-81), and 673 (58%) patients were males (Table 1). EPS was performed in 156 patients (13.5%) for bradyarrhythmia, in 596 (51.8%) for supraventricular tachyarrhythmia, and in 400 (34.7%) for ventricular tachyarrhythmia (Table 1). In total, 789 (68.5%) patients were diagnosed. Two hundred twenty-two (19.28%) patients underwent supraventricular tachycardia (SVT) ablation, and 6 (0.52%) underwent ventricular tachycardia (VT) ablation. Also, device (ICD, pacemakers) implantation was performed in 135 (11.7%) patients (Table 2).

Of the 1152 patients who underwent EPS for diagnosis and treatment purposes, 7 (0.6%) displayed complications (Table 2). The numbers and rates of complications are summarized in Table 2. The maximum number of complications proportional to the number of procedures performed (4, 0.5%) was observed in diagnostic procedures. While no complications were monitored in VT ablation, 1 (0.74%) case of pneumothorax complication was observed after the implantation of a pacemaker. Furthermore, 1 case of thrombophlebitis (0.9%) and 1 case of complete AV block were observed during SVT ablation (Table 2). Regardless of the type of procedure, hematoma that required blood transfusion, stroke, or cases resulting in mortality were not observed.

Discussion

Electrophysiological study (EPS) is an invasive procedure that is used in the diagnosis and treatment of cardiac arrhythmia (4).

Table 1. EPS indications, patient numbers, and gender rates

	Bradyarrhythmia	SVT	VT	TOTAL
Patient (n, %)	156 (%13.5)	596 (%51.8)	400 (%34.7)	1152
Male (n, %)	82 (%12.2)	282 (%41.9)	309 (%45.9)	673 (%58.4)
Female (n, %)	74 (%15.45)	314 (%65.55)	91 (%19)	479 (%41.6)

SVT: supraventricular tachyarrhythmia; VT: ventricular tachyarrhythmia; EPS: electrophysiological study

Table 2. Complications developing depending on the types of the procedures and their rates

	DIAGNOSTIC (n=789)	SVT ABL (n=222)	VT ABL (n=6)	DEVICE IMP. (n=135)
Arterial embolism	1			
Sheat fracture	1			
Tamponade	1			
Hemopericardium	1			
Thrombophlebitis		1		
Complete AV block		1		
Pneumothorax				1
Total	4 (0.5%)	2 (0.9%)	0	1 (0.74%)
Total (n, %)	7/1152, 0.6%			

SVT ABL: supraventricular ablation; VT ABL: ventricular ablation; Device IMP: ICD, Pacemaker implantation

It has a high procedural success rate and results in different major and minor complications (5). For low-volume centers in particular, it is stated that complication rates are higher. In our study, the major and minor complication rates of EPS, which were implemented in a single center by a single team for diagnosis and treatment, were presented in accordance with those in literature.

In literature, various complication rates for different EPS were reported. Depending on the procedure, the EPS complication rate was found to be 1.76% in 1000 patients and 0.66% in a multicenter study (4, 5). The multi-center European Radiofrequency Ablation survey reported the complication rate to be 5.1% (6), whereas the survey of the North American Society of Pacing and Electrophysiology reported the complication rate to be 2.1% in their single-center ablation study conducted on various tachyarrhythmias (7).

In addition, the rate of major complications was reported to be 1.04% in the 2005 Spanish catheter ablation records (8). Prashant Bharadwaj et al. (3) found the complication rate to be 0.45% in their 10-year single-center EPS experience. Giles E O'Hara et al. (9) reported the rate to be 1.4 % in their 14-year ablation experience with 5330 patients. In our country, while the non-fatal complication rate was observed to be 8.3% in the ablation series including 125 patients, in the study conducted by Kamil Adalet et al. (10), it was 7.6% in the ablation procedure performed in 79 patients by Erdem Diker et al. (11). In the pediatric group, Pasha Mosaed et al. (12) found this rate to be 4.2% in their single-center ablation process performed in 112 patients. As for the mortality rates, Horowitz et al. (4) observed a rate of 0.01%, and a rate of 0.03% was reported in Spanish records (8). In our study, the total complication rate was found to be 0.06%, and no mortality was observed. Considering the existing studies in literature, various complication rates from 5.1% to 0.45% exist, and the experience of the center and the differences between the teams that perform EPS and monitor patients after the procedures might be responsible for these different results. Comparing the results of our study with those in existing literature, a rate of 0.6 % is consistent with that found in literature, but it is low compared with the general values. This situation shows that performing EPS in an experienced high-volume single center by the same team and again following patients by the same team in the same center are safe and effective in the diagnosis and treatment of cardiac arrhythmia and that they are an important factor for reducing complication rates.

Our study is a database analysis. All procedures were retrospectively analyzed. Because EPS does not constitute an indication to perform routine echocardiography, routine echocardiography after the procedure was not performed for all patients. As a result, silent pericardial effusion cases developing rarely might have been overlooked, and for this reason, total complication rates might have become relatively lower because of not being able to obtain the accurate pericardial effusion rate.

Furthermore, complications were recorded during the hospitalization and follow-up stages (4 to 24 weeks after ablation), and a database was composed. In addition, possible complications occurring in a few patients might not have been detected be-

cause they could not be monitored after the procedure. Finally, single-center data may not represent the valid performances of all other centers.

Conclusion

Electrophysiological study is an approved invasive procedure used with high success and various complication rates in the diagnosis and treatment of cardiac arrhythmias. According to our experience, despite the wide age range and various procedural practices, EPS with one centralized team can be safe and effective. Similarly, EPS performed in experienced, high-volume centers by the same team result in a similar or higher rate of complications than previous findings in literature.

Ethics Committee Approval: Ethics committee approval was received for this study.

Informed Consent: Written informed consent was not obtained from patients who participated in this study.

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References

1. Prystowsky EN, Klein GJ. Techniques in electrophysiology testing. In: Cardiac arrhythmias: an integrated approach for the clinician. New York (NY): McGraw-Hill; 1994. p. 299-333.
2. Erdem A, Yazıcı M. The Cardiac Electrophysiologic Study. *Abant Med J* 2012; 1: 99-103. [\[CrossRef\]](#)
3. Bharadwaj CP, Datta BR, Sofat CS, Madan CH, Kabde A. Through the looking glass: 10-year single centre experience in cardiac electrophysiology and radiofrequency ablation. *Medical Journal Armed Forces India* 2013; 69: 113-8. [\[CrossRef\]](#)
4. Horowitz LN, Kay HR, Kutalek SP, Discigil KF, Webb CR, Greenspan AM, et al. Risks and Complications of Clinical Cardiac Electrophysiologic Studies: A Prospective Analysis of 1,000 Consecutive Patients. *J Am Coll Cardiol* 1987; 9: 1261-8. [\[CrossRef\]](#)
5. Chen SA, Chiang CE, Tai CT, Cheng CC, Chiou CW, Lee SH, et al. Complications of diagnostic electrophysiologic studies and radiofrequency catheter ablation in patients with tachyarrhythmias: an eight-year survey of 3,966 consecutive procedures in a tertiary referral center. *Am J Cardiol* 1996; 77: 41-6. [\[CrossRef\]](#)
6. Hindricks G. The Multicentre European Radiofrequency Survey (MERFS): complications of radiofrequency catheter ablation of arrhythmias. The Multicentre European Radiofrequency Survey (MERFS) investigators of the Working Group on Arrhythmias of the European Society of Cardiology. *Eur Heart J* 1993; 14: 1644-53. [\[CrossRef\]](#)
7. Scheinman MM. Patterns of catheter ablation practice in the United States: results of the 1992 NASPE survey. *North American Society of Pacing and Electrophysiology. Pacing Clin Electrophysiol.* 1994; 17: 873-5. [\[CrossRef\]](#)
8. Álvarez-López M, Rodríguez-Font E, García-Alberola A. Spanish Catheter Ablation Registry. Fifth official report of the Spanish Society of Car-

- diology Working Group on Electrophysiology and Arrhythmias (2005). *Rev Esp Cardiol* 2006; 59: 1165-74. [\[CrossRef\]](#)
9. GE O'Hara, F Philippon, J Champagne, Blier L, Molin F, Côté JM, et al. Catheter ablation for cardiac arrhythmias: a 14-year experience with 5330 consecutive patients at the Quebec Heart Institute, Laval Hospital. *Can J Cardiol* 2007; 23: 67B-70B. [\[CrossRef\]](#)
 10. Adalet K, Mercanoğlu F, Gündoğdu R. Radyofrekans Katater Ablasyonu Uygulanan Supraventriküler ve Ventriküler Taşikaritmik Hastalarda Seri Ekokardiyografik İnceleme ile Komplikasyonların Araştırılması. *Türk Kardiol Dern Arş* 1997; 25: 170-5.
 11. Diker E, Tezcan UK, Özdemir M. Kardiyak Aritmilerin Radyofrekans Katater Ablasyon Tekniği ile Tedavisi. *Türk Kardiol Dern Arş* 1996; 24: 136-143.
 12. Mosaed P, Dalili M, Emkanjoo Z. Interventional Electrophysiology in Children: A Single-Center Experience. *Iran J Pediatr* 2012; 22: 333-8.