

Special article

Spanish Catheter Ablation Registry. 14th Official Report of the Spanish Society of Cardiology Working Group on Electrophysiology and Arrhythmias (2014)



Ignacio Gil-Ortega,^{a,*} Alonso Pedrote-Martínez,^b and Adolfo Fontenla-Cerezuela^c on behalf of the Spanish Catheter Ablation Registry collaborators[◇]

^aUnidad de Arritmias, Hospital Universitario Santa Lucía, Cartagena, Murcia, Spain

^bUnidad de Arritmias, Hospital Universitario Virgen del Rocío, Seville, Spain

^cUnidad de Arritmias, Hospital Universitario 12 de Octubre, Madrid, Spain

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ABSTRACT

Introduction and objectives: This report presents the findings of the 2014 Spanish Catheter Ablation Registry.

Methods: For data collection, each center was allowed to choose freely between 2 systems: retrospective, requiring the completion of a standardized questionnaire, and prospective, involving reporting to a central database.

Results: Data were collected from 85 centers. A total of 12 871 ablation procedures were performed, for a mean of 149.5 ± 103 procedures per center. The ablation targets most frequently treated were atrioventricular nodal reentrant tachycardia ($n = 3026$; 23.5%), cavotricuspid isthmus ($n = 2833$; 22.0%), and atrial fibrillation ($n = 2498$; 19.4%). The number of ablation procedures for ventricular arrhythmias was similar to that of 2013, but there was a slight increase in the treatment of all the ventricular substrates, especially those associated with idiopathic ventricular tachycardia and scarring following myocardial infarction. The overall success rate was 95%, the rate of major complications was 1.3%, and the mortality rate was 0.02%.

Conclusions: The 2014 registry shows that the number of ablation procedures performed continued its upward trend and that, overall, the success rate was high and the number of complications low. Ablation of complex conditions continued to increase.

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Registro Español de Ablación con Catéter. XIV Informe Oficial de la Sección de Electrofisiología y Arritmias de la Sociedad Española de Cardiología (2014)

RESUMEN

Introducción y objetivos: Se detallan los resultados del Registro Español de Ablación con Catéter del año 2014.

Métodos: La recogida de datos se llevó a cabo mediante dos sistemas: retrospectivo, mediante cumplimentación de un formulario, y prospectivo, a través de una base de datos común. La elección de uno u otro fue voluntaria de cada uno de los centros.

Resultados: Se recogieron datos de 85 centros. El número total de procedimientos de ablación fue 12.871, con una media de $149,5 \pm 103$ procedimientos. Los tres sustratos abordados con más frecuencia fueron la taquicardia intranodular ($n = 3.026$; 23,5%), la ablación del istmo cavotricuspidéico ($n = 2.833$; 22,0%) y la fibrilación auricular ($n = 2.498$; 19,4%). La ablación de arritmias ventriculares ha permanecido estable, con un ligero incremento de todos los sustratos ventriculares, en especial las taquicardias ventriculares idiopáticas y las asociadas a cicatriz tras infarto. La tasa total de éxito fue del 95%; la de complicaciones mayores, del 1,3% y la de mortalidad, del 0,02%.

Conclusiones: En el registro del año 2014 se mantiene una línea de continuidad ascendente en el número de ablaciones realizadas y muestra, en líneas generales, una elevada tasa de éxito y bajo número de complicaciones. Continúa el aumento del abordaje de sustratos más complejos.

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Palabras clave:

Ablación con catéter
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* Corresponding author: Unidad de Arritmias, Servicio de Cardiología, Hospital Universitario Santa Lucía, Mezquita s/n, Paraje de los Arcos, 30202 Cartagena, Murcia, Spain.
E-mail address: ignaciogilortega@gmail.com (I. Gil-Ortega).

◇ See Appendix 1 for the complete list of collaborators.

Abbreviations

AF: atrial fibrillation
 AP: accessory pathway
 AVNRT: atrioventricular nodal reentrant tachycardia
 VT-ICM: ventricular tachycardia in ischemic cardiomyopathy
 VT-NICM: ventricular tachycardia in nonischemic cardiomyopathy

INTRODUCTION

This report presents the findings of the Spanish Catheter Ablation Registry, the official registry of the Working Group on Electrophysiology and Arrhythmias of the Spanish Society of Cardiology, corresponding to 2014, thus marking the 14th year of uninterrupted activity by this group.^{1–13} The registry is a voluntary nationwide record, published annually, that includes data from most of the arrhythmia units operating in Spain, which makes it one of the few large-scale, observational registries focusing on catheter ablation.

The main objectives of the registry are to observe and describe developments in the interventional treatment of cardiac arrhythmias in Spain and to provide reliable information on the type of activity carried out and the facilities available in Spanish arrhythmia units.

METHODS

As in previous years, 2 different systems, one prospective and the other retrospective, were available for data collection. For the prospective method, the registry provided a standardized database that required the introduction of individual patient data. The retrospective approach involved completing a standardized questionnaire that was sent to all the participating interventional electrophysiology laboratories in January 2015; the questionnaire was also available at the website of the Working Group on Electrophysiology and Arrhythmias.¹⁴ All the data compiled by both systems remained anonymous, even to the registry coordinators. The secretariat of the Spanish Society of Cardiology ensured that the participating centers could not be identified.

The information collected concerned the technical and human resources available in the arrhythmia units, the procedures performed, and the patients' demographic data. As in previous years, the data on human resources included information only from centers in the publicly-funded health system, and the epidemiologic variables included only those from patients treated in centers using the prospective data collection method.

We analyzed the same 10 arrhythmias and arrhythmogenic substrates that were examined in previous registries: atrioventricular nodal reentrant tachycardia (AVNRT), accessory pathway (AP), atrioventricular node ablation, focal atrial tachycardia, cavotricuspid isthmus, macroreentrant atrial tachycardia, atrial fibrillation (AF), idiopathic ventricular tachycardia, ventricular tachycardia in ischemic cardiomyopathy (VT-ICM), and ventricular tachycardia in nonischemic cardiomyopathy (VT-NICM). The following variables common to these 10 conditions were analyzed: the number of patients and procedures performed, success rate, type of ablation catheter used, and the number and type of procedure-related complications, including periprocedural death. In addition, we analyzed a number of substrate-specific variables,

such as the anatomic location and type of AP conduction, the location and mechanism of atrial tachycardia, and the type of ventricular tachycardia.

As in previous years, the success rate refers only to the immediate postprocedural data (acute success rate). The number of recurrences could not be identified because there was no follow-up analysis. Several therapeutic approaches with different objectives can be used to treat AF and VT-ICM, and the criteria for success/failure may differ depending on the technique applied. Thus, AF, VT-ICM, and VT-NICM were excluded from the analysis of the overall outcome of ablation procedures. As for complications, only those occurring during the hospital stay following the procedure were reported.

Statistical Analysis

Continuous variables are expressed as the mean \pm standard deviation. Differences between continuous variables were evaluated using Student's *t* test for dependent or independent samples, as appropriate. Differences between categorical variables were assessed using the chi-square or Fisher exact test. Statistical significance was set at a *P* value of $<.05$. The statistical analysis was carried out using an SPSS (20.0) database.

RESULTS

In keeping with the general trend of recent years, there were significant increases in both the number of centers participating in the registry and the total number of ablation procedures performed. Eighty-five centers contributed to the 2014 registry (Appendix 2) and, for the first time, the total number of ablation procedures neared 13 000 (Figure 1), repeating the upward trend observed each year. The participating centers included 68 (80%) from the publicly-funded health system and 17 from the private sector.

As has been the case since the first publication of the registry, retrospective data collection was the most widely used approach. Only 9 centers (10.5%) provided prospectively collected data.

Once again, the participating hospitals were mainly tertiary (85%) and teaching (70%) centers. Patients were attended to in cardiology departments in 80 (94.1%) of the 85 participating centers, and 60% had cardiac surgery units.

Epidemiological Characteristics

As in previous registries, the epidemiological characteristics were analyzed using patient data only from centers providing prospective data. In 2014, there were 9 such centers (1 more than in 2011, 2012, and 2013, years in which 8 of the participating centers used this format); these 9 centers reported a total of 1857 ablation procedures.

The overall mean age of the patients was 44 ± 15 years. The mean ages corresponding to the 10 different ablation targets ranged between 36 ± 9.8 years for AP ablation and 73 ± 7 years for atrioventricular node ablation. Regarding the distribution by sexes, most of the AVNRT ablation procedures were carried out in women (79%), whereas ablation of AF or of ventricular tachycardia, with or without associated structural heart disease, was mostly performed in men (75% and 71%, respectively). These data are virtually identical to those reported in previous registries.

Again, consistent with the findings in previous years, 41% of the patients had a history of structural heart disease, and left ventricular dysfunction was generally limited to patients undergoing atrioventricular node ablation or ablation of ventricular

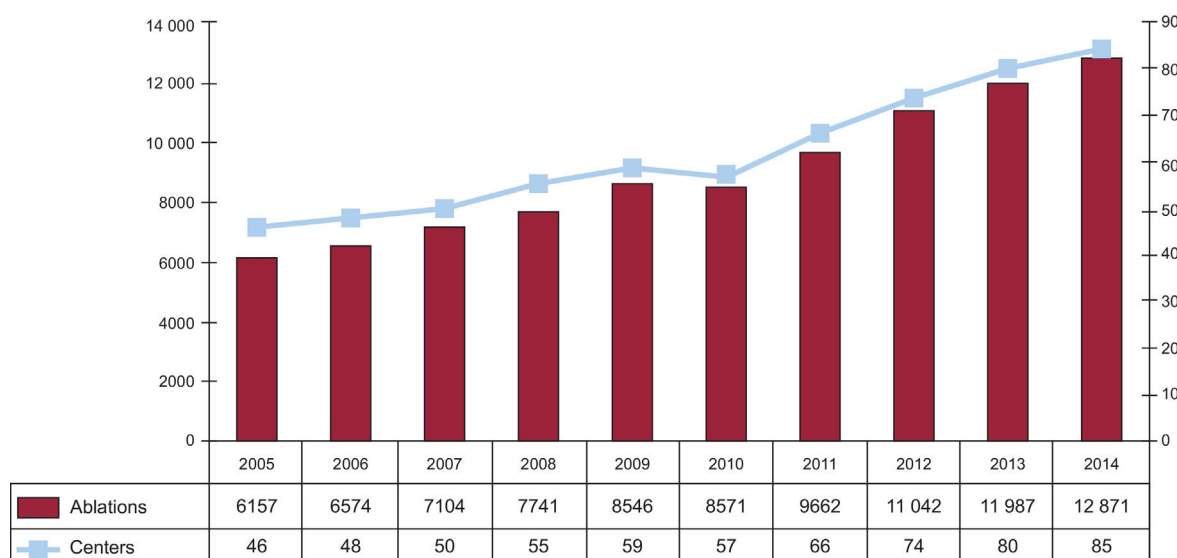


Figure 1. Data analyzed.

tachycardia associated with heart disease (VT-NICM). The same distribution was observed in the group of patients with implantable cardioverter defibrillators.

Infrastructure and Resources

The technical and human resources available in the arrhythmia units participating in the 2014 registry and the activity carried out are presented in Tables 1 and 2.

Fifty-three centers (61.6%) were equipped with at least 1 dedicated cardiac electrophysiology laboratory, and 7 centers (8.2%) had 2 such laboratories. As in previous years, the laboratory was available 3.7 ± 1.4 (median, 4) days a week. Only 3 of the 17 private centers had an area devoted exclusively to cardiac electrophysiology.

External electric cardioversion was performed in 52 laboratories and internal cardioversion in only 22 of these centers. Most units, although in a slightly lower percentage than in 2013 (78.8%), were also equipped to perform implantation of cardiac pacing devices, mainly defibrillators: implantation of both defibrillators and pacemakers was performed in 74.4% of the laboratories, defibrillator implantation alone in 3.5%, and pacemaker implantation alone in 2.3%.

All the participating centers were equipped with a digital recording system, 52% with digital radiography, and 41% with portable fluoroscopy. A single nonfluoroscopic navigation system was available in 79% of the centers; 27% had 2 such systems, and 1.2% had 3. Although the differences were less marked than in the 2013 registry, nonfluoroscopic navigation systems were more widely available in publicly-funded centers than in private ones (75% vs 59%).

The number of remote navigation systems was slightly lower than in previous years. Two centers had a magnetic navigation system and 2 a robotic navigation system. The number of sites performing intracardiac echocardiography also decreased (to 18, representing a reduction from 25% in 2013 to 21% in 2014). Ultrasound ablation was available at a single site, as reported in previous registries. However, the number of centers offering cryoablation continued to grow (48, representing an increase from 52.5% in 2013 to 56% this past year).

After the slight decrease in the number of health care professionals working in electrophysiology laboratories reported in recent years, this decline appears to have leveled off in 2014,

with data similar to those of the 2013 registry.¹³ In all, 76.4% of the centers had more than 1 full-time physician, and 47% had more than 2, figures considerably higher than those of the registry of the preceding year.¹³ One noteworthy finding was that 23 health

Table 1

Characteristics and Infrastructure of the 85 Electrophysiology Laboratories That Participated in the 2014 Registry

Teaching hospitals	60 (70.5)
Level	
Tertiary	72 (84.7)
Secondary-regional	13 (15.3)
Health care system	
Public	68 (80)
Fully private	17 (20)
Department responsible	
Cardiology	80 (94.1)
Cardiac surgery	51 (60)
Availability of the laboratory	
Exclusive use	53 (62.3)
Used for electrophysiology (days)	3.7 ± 1.4 [4]
Digital recording system	85 (100)
Digital radiography	45 (52.9)
At least one NFNS	67 (79)
Magnetic navigation	2 (2.3)
Robotic navigation	2 (2.3)
Cryoablation	48 (56.4)
Intracardiac echocardiography	18 (23.5)
Device implantation	
No	14 (16.3)
ICD	3 (3.5)
ICD and pacemaker	64 (75.4)
Elective ECV	
No	32 (37.7)
ECV	31 (36.4)
ICV	1 (1.1)
ECV and ICV	22 (25.8)

ECV, external cardioversion; ICD, implantable cardioverter-defibrillator; ICV, internal cardioversion; NFNS, nonfluoroscopic navigation system. Data are expressed as No. (%) or mean \pm standard deviation [median].

Table 2

Changes in the Human Resources in Electrophysiology Laboratories of the Spanish Public Health System That Participated in the Registry Since 2006 (Mean No. per Hospital)

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Staff physicians	2.3	2.4	2.5	2.6	2.8	2.6	2.7	2.8	2.8
Full-time physicians	1.8	2.1	2.1	2.1	2.3	2.2	2.1	2.0	1.9
Residents/y	1.3	0.6	0.6	0.8	0.7	0.7	0.7	0.6	0.6
NG	1.7	2.0	2.2	2.2	2.4	2.3	2.3	2.2	2.3
RT	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4

NG, nursing graduate; RT, radiologic technologist.

care centers had 4 staff physicians working full-time in electrophysiology laboratories, in contrast to the 10 centers reported in 2013. The staff of 74.1% of the laboratories included at least 2 full-time nursing graduates. In 2014, 28 centers had resident physicians, in most cases 1 or 2 (1 hospital had 8 residents).

Overall Results

In 2014, a total of 85 centers submitted their data to the registry, the highest level of participation since its inception (Figures 1 and 2). In all, 12 871 procedures were reported, yielding a mean of 149.5 ± 103 (median, 124; range, 7–486) procedures per site. Only 8 private centers performed more than 50 ablation procedures per year, and 3 of them exceeded 200 per year. Seven public health centers carried out more than 300 ablations (2 of them, more than 400).

The overall success rate was 95%, excluding the treatment of AF, VT-ICM, and VT-NICM. Among the total number of ablation procedures performed (including AF, VT-ICM, and VT-NICM), 237 complications were notified (1.8%). A total of 8 deaths were reported (0.06%), twice the number in 2013: 1 patient died during AVNRT ablation, another 6 during ablation for VT-ICM, and the eighth during ablation for macroreentrant atrial tachycardia. No deaths were reported in AF ablation procedures. There were 14 cases of iatrogenic atrioventricular block (0.1%) requiring permanent pacemaker implantation: 10 during AVNRT ablation

(exactly twice the number recorded in 2013), 1 during AP ablation, 2 during cavotricuspid isthmus ablation, and 1 during VT-ICM ablation. The overall success and complications rates in 2014, compared with the rates in previous years, are shown in Figures 3 and 4. The success rates for the different procedures have remained steady, with a certain degree of recovery of the results for ablation to treat ventricular tachycardia in heart disease in general (VT-NICM), which, after a decrease from 77% to 69% reported in the previous registry, rose to 77.7% in 2014. These variations could be related to the criteria used to determine success in these arrhythmias, which differ between laboratories. The incidence of complications has leveled off in recent years, with outcomes similar to those recorded in the 2013 registry.¹³ Once again, of the ablation targets reported, AVNRT was that most frequently treated, followed by cavotricuspid isthmus. For the second year in a row, after being observed for the first time in the 2013 registry, AF ablation was the third most frequently performed intervention (Figure 5). The number of procedures rose for all the ablation targets, including VT-ICM, which had shown a 3% drop in recent years. There was a decrease of 3% (54 fewer procedures) in AP ablation. The most significant increases occurred in the treatment of AF, macroreentrant atrial tachycardia and, in general, in ablation of ischemic and nonischemic heart disease-related ventricular tachycardia (VT-ICM and VT-NICM). The number of AF ablation procedures continued to increase, accounting for 19% of all the procedures carried out, and was, as mentioned above, the third most frequently performed intervention, ahead of AP

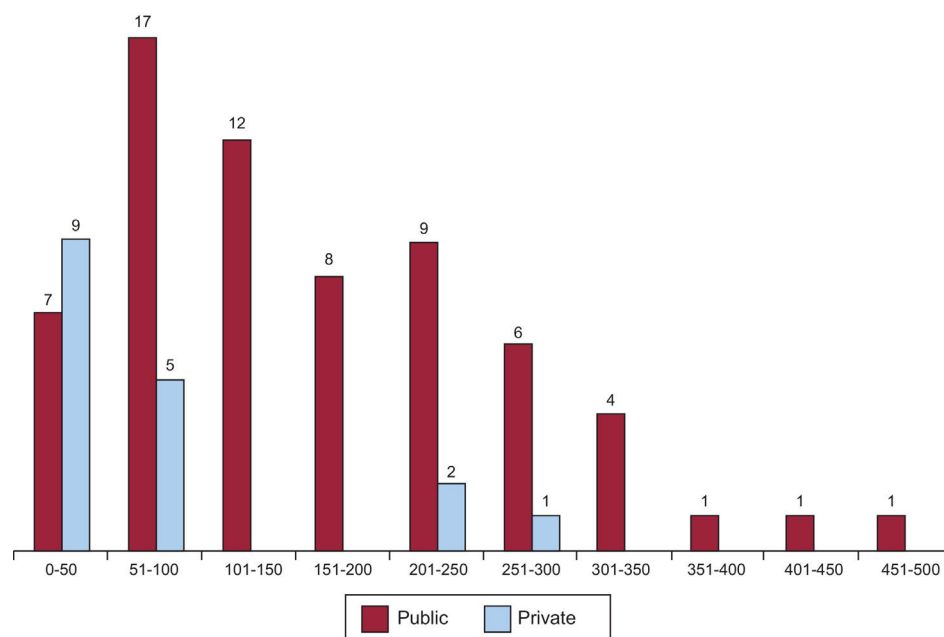


Figure 2. Number of electrophysiology laboratories participating in the registry by number of ablation procedures performed in 2014.

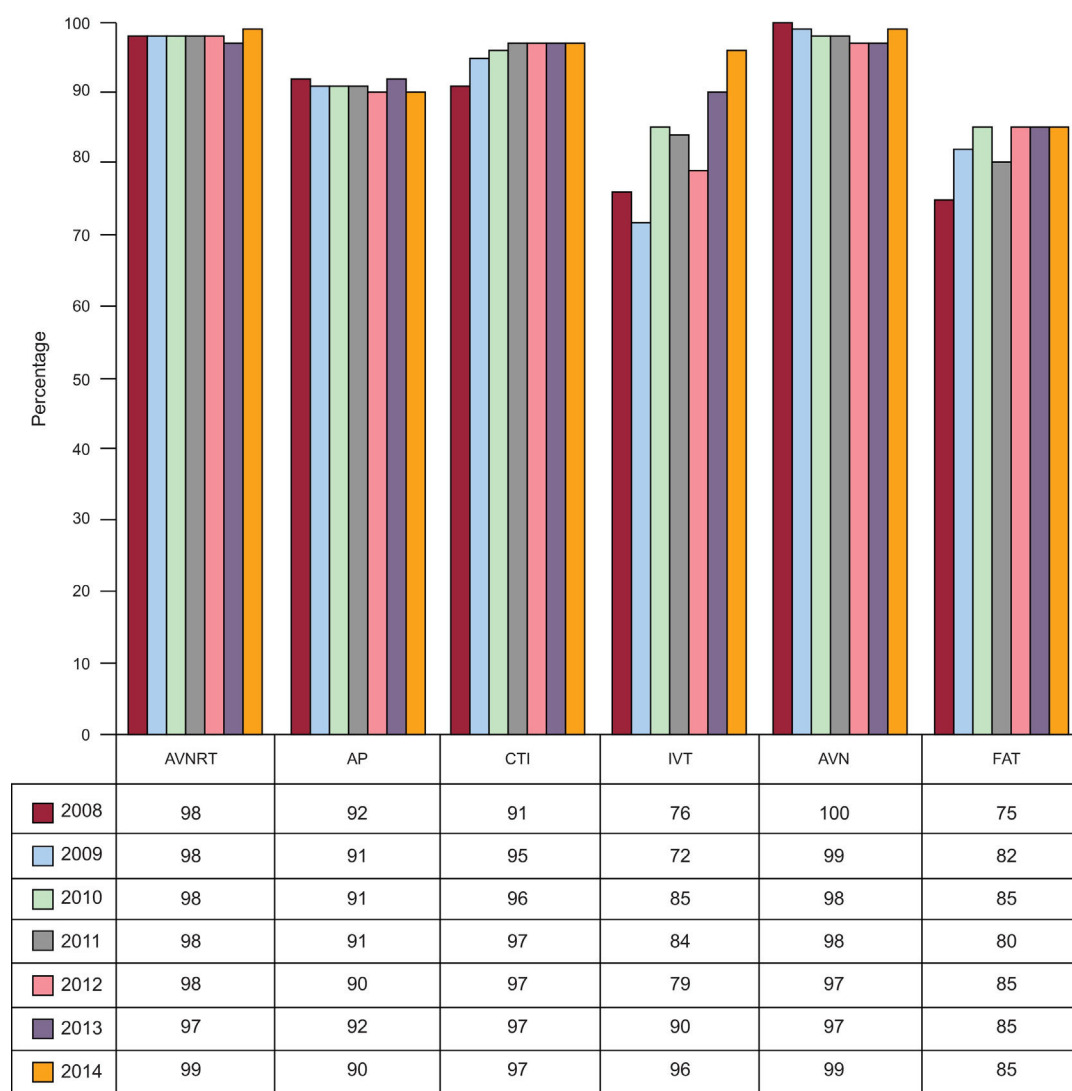


Figure 3. Changes in catheter ablation success rates since 2008 by arrhythmia or arrhythmogenic substrate treated. AP, accessory pathway; AVN, atrioventricular node; AVNRT, atrioventricular nodal reentrant tachycardia; CTI, cavotricuspid isthmus; FAT, focal atrial tachycardia; IVT, idiopathic ventricular tachycardia.

ablation, which, in this registry, represented only 15% of the ablation procedures performed. Ablation for VT-NICM continued to be the least common procedure (2%).

The changes in the relative frequency of procedures for the treatment of the various arrhythmias and arrhythmogenic substrates are shown in Figure 6.

In 2014, AVNRT and AP were the only ablation targets treated in all 85 centers. Cavotricuspid isthmus was treated in 97.6% and atrioventricular node in 88.2% (Figure 7). The condition treated at the fewest centers continued to be VT-NICM (although it increased from 48.7% of the participating centers in 2013 to 55.3% in 2014). The number of centers performing AF ablation rose from 50 in 2012 and 52 in 2013 to 59 centers in 2014, representing 69.5% of all the centers and 70.5% of those in the public health system.

The following sections summarize the results of the data analysis for each specific arrhythmia or arrhythmogenic substrate.

Atrioventricular Nodal Reentrant Tachycardia

Atrioventricular nodal reentrant tachycardia was, once again, the most frequently targeted condition, and catheter ablation of this arrhythmia was carried out in all centers. A total of

3026 AVNRT ablation procedures were performed (23.5% of all the ablations), with a mean of 35.6 ± 23.5 interventions per site (range, 2-105). The overall success rate was 98.7%, and 58 centers (69%) had a rate of 100%. There were 20 complications (0.6%), including 10 cases of atrioventricular block requiring a permanent pacemaker, 7 vascular access complications, and 1 death of unknown cause. Another patient with severe heart disease experienced resuscitated cardiac arrest. The most commonly used ablation catheter was a conventional 4-mm tip radiofrequency catheter. In addition, an irrigated tip catheter was used in 137 cases, a cryoablation catheter in 78, and an 8-mm tip catheter in 18.

Cavotricuspid Isthmus

Ablation of the cavotricuspid isthmus continued to be the second most frequent procedure, performed in 83 centers (97.6%). In all, it was carried out in 2833 cases (22%), with a mean of 34.1 ± 27 (range, 1-120) procedures per center. Success was reported in 97% of the cases, with a 100% success rate in 43 centers. There were 36 major complications (1.2%), including 12 vascular complications, 2 cases of atrioventricular block requiring a permanent pacemaker, 2 episodes of stroke, 1 case of heart failure, and 1 case of pericardial

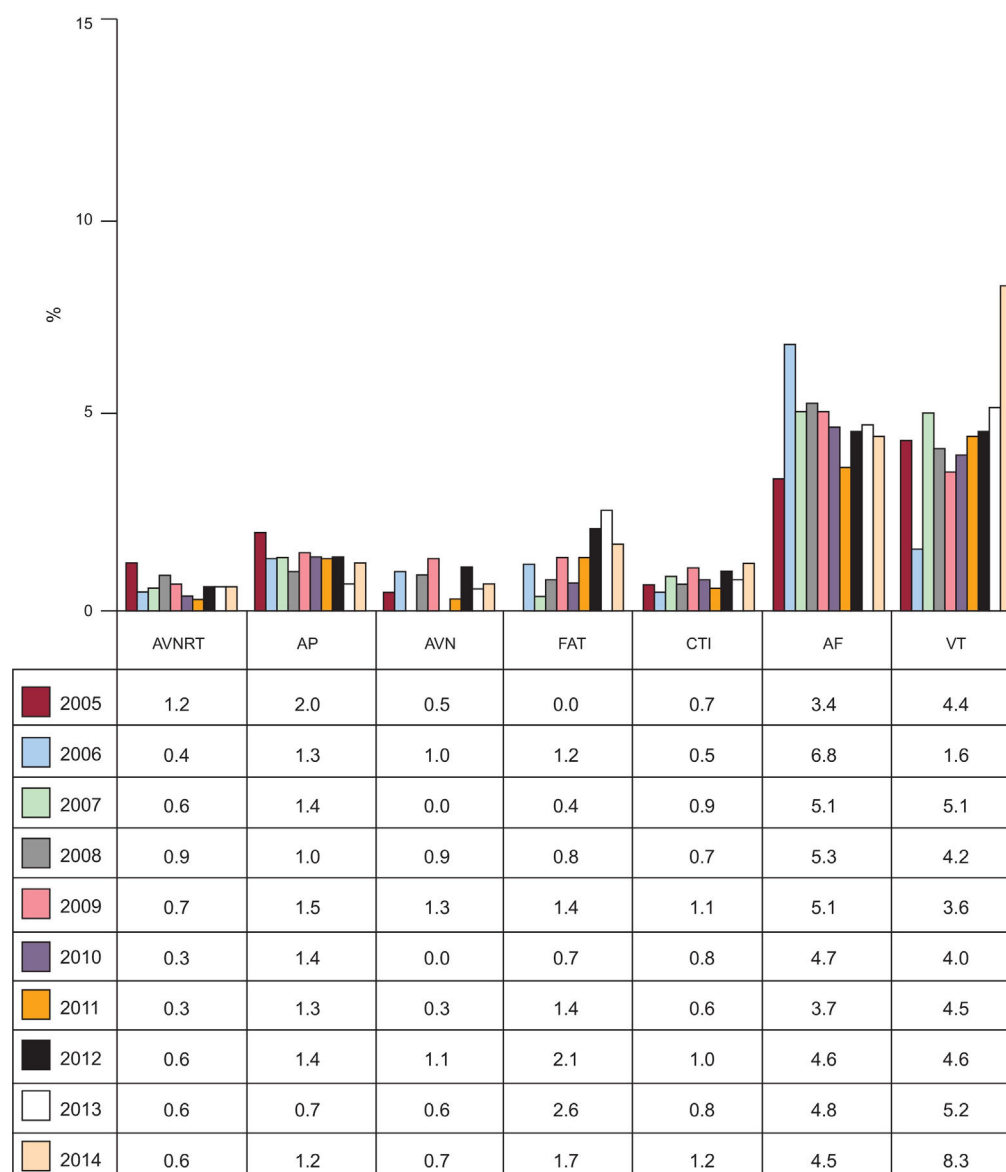


Figure 4. Percentage of major complications related to catheter ablation since 2005 by arrhythmia or arrhythmogenic substrate treated. AF, atrial fibrillation; AP, accessory pathway; AVN, atrioventricular node; AVNRT, atrioventricular nodal reentrant tachycardia; CTI, cavotricuspid isthmus; FAT, focal atrial tachycardia; VT, ventricular tachycardia.

effusion/tamponade. The devices employed included 1690 irrigated tip, 951 8-mm tip, 16 10-mm tip, and 3 cryoablation catheters.

Accessory Pathways

Once again, AP ablation was the fourth most frequently performed procedure, and was carried out in all the centers, although with a slight decrease in the number of interventions. There were 1946 AP procedures, yielding a mean of 22.8 ± 16.8 per site (range, 1–75), and 1749 (89.9%) had a successful outcome. Twenty-eight centers achieved a success rate of 100%. Nonetheless, on separate analysis of the 60 centers reporting more than 10 AP ablation procedures a year, only 10 reached 100%. Many centers still do not provide information on the direction of AP conduction. The available data indicate that 52% of the AP exhibited bidirectional conduction, whereas conduction was exclusively anterograde in 9.8% and retrograde in 38.1%. With respect to the locations of the abnormal

pathways, the percentages were similar to those of previous years. Left-sided AP continued to be the most common finding (51%), followed by inferoseptal (25.5%), and right-sided (14%) AP. Parahisian pathways were the least common (9.5%). Procedural success according to AP location was as follows: left ventricular free wall, 94.6%; right ventricular free wall, 81.5%; inferoparaseptal, 89%; and parahisian/anteroseptal, 78.1%. There were 25 (1.3%) major complications, including 13 vascular complications, 8 cases of pericardial effusion, 2 strokes, and 1 case of atrioventricular block requiring a permanent pacemaker. Nonconventional ablation catheters were employed in fewer procedures: irrigated tip catheters were used in 293 cases, cryoablation catheters in 78, and 8-mm tip catheters in 22.

Atrioventricular Node Ablation

In all, 540 atrioventricular node ablation procedures were reported by 75 centers. Success was achieved in 98.8% of the cases.

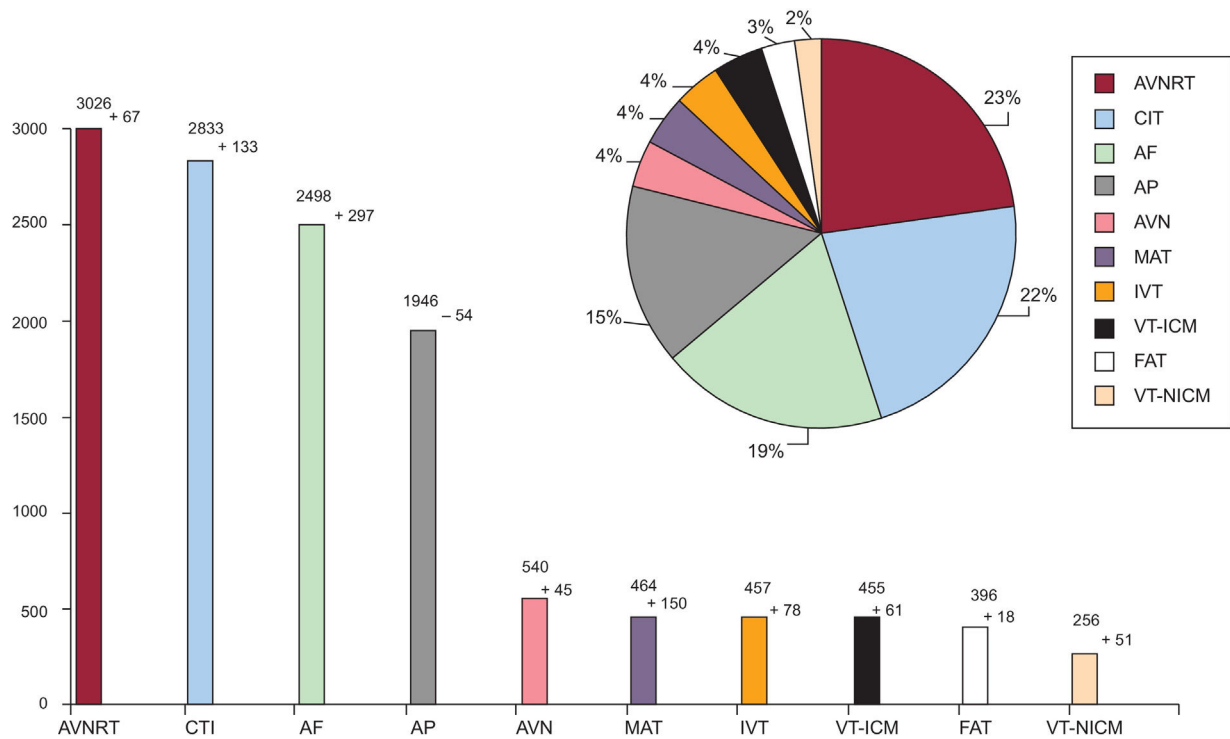


Figure 5. Relative frequency of arrhythmias and arrhythmogenic substrates treated by catheter ablation recorded in the 2014 registry (n = 12 871). The change in the number of cases with respect to the 2013 registry is shown for each ablation target. AF, atrial fibrillation; AP, accessory pathway; AVN, atrioventricular node; AVNRT, atrioventricular nodal reentrant tachycardia; CTI, cavotricuspid isthmus; FAT, focal atrial tachycardia; IVT, idiopathic ventricular tachycardia; MAT, macroreentrant atrial tachycardia/atypical atrial flutter; VT-ICM, ventricular tachycardia in ischemic cardiomyopathy; VT-NICM, ventricular tachycardia in nonischemic cardiomyopathy.

There were 4 complications (0.7%), 3 of them vascular. Ablation catheters other than the conventional 4-mm tip catheters were used in 158 cases: 75 irrigated tip, 73 8-mm tip, and 10 cryoablation catheters.

Focal Atrial Tachycardia

In all, 396 focal atrial tachycardia ablation procedures were performed in 74 centers, with an overall success rate of 84.6%. The

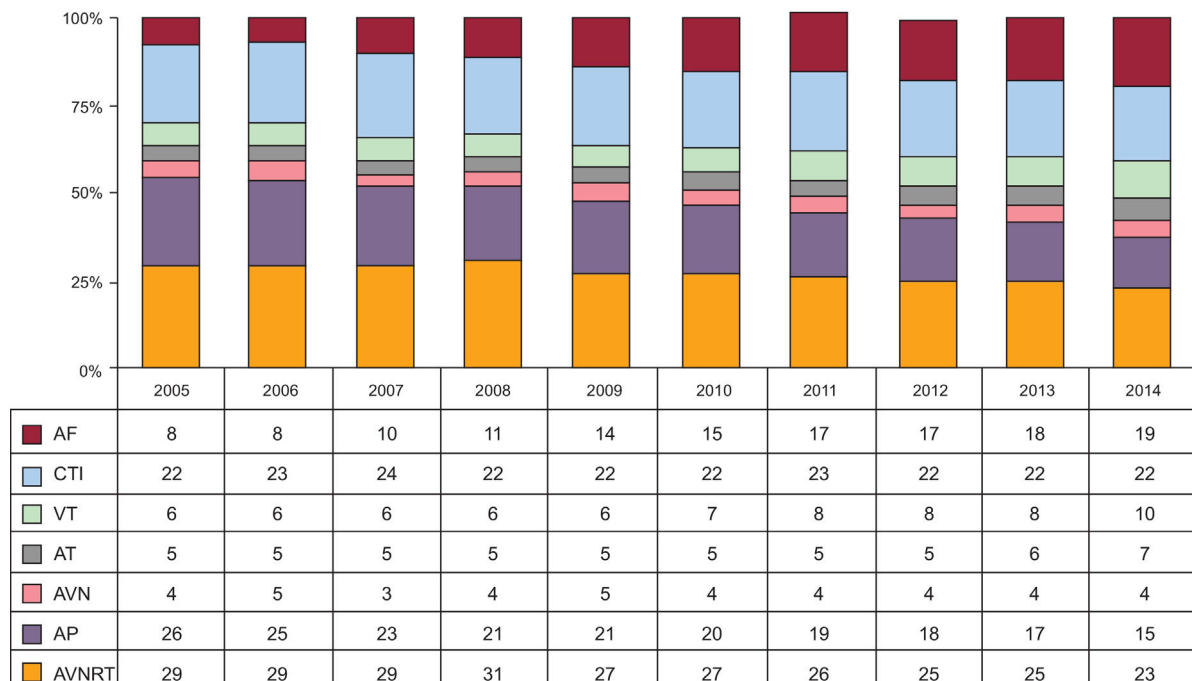


Figure 6. Changes in the relative frequency of different ablation targets treated since 2005. AF, atrial fibrillation; AP, accessory pathway; AVN, atrioventricular node; AVNRT, atrioventricular nodal reentrant tachycardia; CTI, cavotricuspid isthmus; AT, atrial tachycardia; VT, ventricular tachycardia.

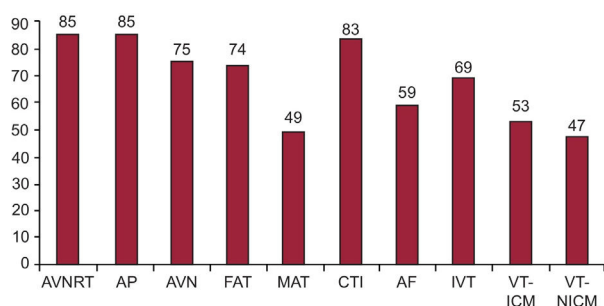


Figure 7. Number of electrophysiology laboratories participating in the 2014 registry that treat each of the different ablation targets. AF, atrial fibrillation; AP, accessory pathway; AVN, atrioventricular node; AVNRT, atrioventricular nodal reentrant tachycardia; CTI, cavotricuspid isthmus; FAT, focal atrial tachycardia; IVT, idiopathic ventricular tachycardia; MAT, macroreentrant atrial tachycardia/atypical atrial flutter; VT-ICM, ventricular tachycardia in ischemic cardiomyopathy; VT-NICM, ventricular tachycardia in nonischemic cardiomyopathy.

data provided show that the intervention was performed for focal atrial tachycardia localized in right atrium in 266 cases (88% of which were successful) and in the left atrium in 92 (85.8% successful), with an increase in the number of centers that treated left-sided focal atrial tachycardia ($n = 46$) compared with 2013. Seven complications (1.8%) were reported, including 2 vascular complications, 1 case of pericardial effusion, 1 periprocedural myocardial infarction, and 1 case of heart failure. Again, there was an increase in the use of special catheters for the ablation of this arrhythmia. In 2014, 193 were used, mostly irrigated tip catheters ($n = 168$), the remainder being cryoablation ($n = 16$) and 8-mm tip ($n = 9$) catheters.

Macroreentrant Atrial Tachycardia/Atypical Atrial Flutter

This ablation target was treated in 49 centers (58%) in a total of 464 procedures (mean, 5.45 procedures per center; range, 1-103), 159 more than in 2013. Success was documented in 407 procedures (88%). There were 5 complications (1.1%): 2 femoral vascular complications, 2 cases of cardiac tamponade, and 1 death (no cause was reported).

The origin of tachycardia was notified in 285 procedures: the right atrium was identified in 145 cases and the left atrium in 140, with success rates of 84.8% and 76.4%, respectively. In 87.7% of the cases, devices other than conventional 4-mm tip catheters were used, mainly irrigated tip catheters in 241 cases (51.9%) and 8-mm tip catheters in 148 (31.9%).

Atrial Fibrillation

A total of 2498 AF ablation procedures were carried out in 59 (69%) of the participating centers (range, 1-159). This activity represents an increase of 297 ablations (13.5%) compared with the 2013 registry (which had shown an 18.8% increase compared with 2012), with a mean of 29.4 procedures per center. Seven catheterization laboratories performed less than 10 procedures, and 24 less than 25. Sixteen centers carried out more than 50 and, in this group, only 5 performed more than 100 procedures. Among the total, 65.7% (1641 procedures) were for paroxysmal AF and 43.2% (1079 procedures) were for persistent AF. Of the ablation procedures for persistent AF, 149 were for long-standing and 17 for very long-standing AF. The entry referring to ablation for permanent AF was deleted from this registry as it represents a conceptual error.

The treatment approach used was reported in 2047 (81.9%) of the procedures: electrical disconnection at the pulmonary vein ostium in 6.6% of the cases, circumferential isolation with the aim of disconnection in 74.4%, and circumferential isolation to reduce electrical connections in the remaining 1.3%. The right atrium was treated in 69 (2.8%) of the procedures.

Nearly all the teams (74.4%) used irrigated-tip catheters. In 2014, number of procedures performed with cryoballoon increased ($n = 674$ [27%]), up from 20.8% in 2013. The present registry includes reports of AF ablation procedures using new single-shot systems: nMARQ® (69 procedures [2.8%]) and laser ablation (30 procedures [1.2%]). The use of steerable sheaths decreased, employed in a total of 357 cases (14.3% of all the procedures vs 20.7% in the 2013 registry), despite being used in a larger number of centers: they were utilized in 19 centers in 2014 and in 9 in 2013.

There were 113 complications (4.5%, very similar to the percentage in 2013) reported as follows: significant pericardial effusion/cardiac tamponade ($n = 52$ [2%]), vascular access ($n = 35$ [1.4%]), pericarditis ($n = 11$ [0.4%]), stroke ($n = 3$ [0.1%]), phrenic nerve palsy ($n = 7$ [0.3%]), infarction/angina ($n = 2$ [0.1%]), pulmonary vein stenosis ($n = 1$ [0.04%]), congestive heart failure (1 [0.04%]), and gastroesophageal ulcer (1 [0.04%]). There was 1 case of postprocedural esophageal ulceration with no evidence of atrioesophageal fistula. There were no deaths.

Idiopathic Ventricular Tachycardia

Idiopathic ventricular tachycardia ablation was carried out in 457 procedures in 69 centers (81%) (mean, 5.4 procedures per center; range, 1-23). In all, 438 procedures were successful (95.8%), and there were 14 complications (3.1%): 9 vascular complications (2.0%), 4 cases of cardiac tamponade (2.0%), and 1 atrioventricular block (0.2%).

The type of ventricular tachycardia treated was specified in 424 procedures (92.7%): right ventricular outflow tract in 264; left ventricular outflow tract in 74; fascicular tachycardia in 47, and ventricular tachycardias other than the above (reported as *other locations*) in 39 procedures. Ablation was successful in 83.7%, 79.7%, 91.5%, and 80.0% of these procedures, respectively. The focal site of origin of the condition was the aortic root in 22 cases, the pulmonary artery in 24, and the interior of a coronary vein in 3.

Catheters other than the 4-mm tip device were used in 71.5% of the cases. An irrigated tip catheter was used in 305 cases (66.7%), an 8-mm tip catheter in 9 (2.0%), and a cryoablation catheter in 20 (4.4%).

Ventricular Tachycardia in Ischemic Cardiomyopathy

In all, VT-ICM was treated in 53 centers (62%) performing 455 ablation procedures (5.4 per center; range, 1-28).

The type of ablation performed was specified in 90.3% of the cases: a "conventional" approach was used in 99 cases and a substrate approach in 312 (a proportion similar to that reported in 2013). The overall success rate was 81.2% (lower than the rate of 90.8% reported in 2013). The success rate was 83.8% with the conventional approach and 85.6% with the substrate approach. The access route was reported in 75% of the cases: 290 endocardial, 18 epicardial, and 36 endocardial and epicardial, indicating an increase in the percentage involving epicardial access over that recorded in 2013 (15.7% vs 11.8%). The complications ($n = 38$ [8.4%]) involved: vascular access ($n = 7$ [1.5%]), cardiac tamponade ($n = 10$ [2.2%]), stroke ($n = 4$ [0.9%]), heart failure ($n = 10$ [2.2%]), and atrioventricular block ($n = 1$ [0.2%]). Two patients (0.4%) died after the procedure due to heart failure.

An irrigated-tip ablation catheter was used in most cases of VT-ICM (96.2%). Steerable sheaths were employed in 122 cases (26.8%).

Ventricular Tachycardia in Nonischemic Cardiomyopathy

A total of 254 VT-NICM ablation procedures were performed in 47 laboratories (55%) (3 procedures per center; range 1–32). These included 39 interventions for arrhythmogenic cardiomyopathy (success rate, 76.9%), 15 for bundle branch reentrant ventricular tachycardia (success rate, 100%), 98 for nonischemic dilated cardiomyopathy (success rate, 71.4%), 78 for nonsustained ventricular tachycardia (success rate, 87.2%), and 24 for conditions reported as being of *another type* (success rate, 75%).

There were 10 complications (3.9%): 2 episodes of heart failure (0.8%), 2 atrioventricular blocks (0.8%), 1 vascular complication (0.4%), and 5 cases of cardiac tamponade (2.0%), with 1 death from this cause in the context of an epicardial approach.

A catheter other than the 4-mm tip model was employed in 90.8% of the cases. An irrigated-tip catheter was used in 220 (85.9%) of the procedures, an 8-mm tip catheter in 4 (1.6%), and a cryoablation catheter in 20 (3.1%).

DISCUSSION

Once again, the present catheter ablation registry shows an increase in the number of participating centers in 2014, making it even more representative of the situation regarding ablation procedures in Spain. In all, 85 centers participated, surpassing the 80 that took part in 2013, which, at that time, was the largest number ever. The mean number of ablation procedures per site maintained the same proportion as that of the 2013 registry, but the total number of ablations performed exceeded those reported for that year by nearly 1000 procedures.

In 2014, the human resources in terms of health care professionals were maintained at the same level, interrupting the downward trend of the last few years. As occurred in previous years, there was a slight increase in the number of physicians dedicated to electrophysiology, but a decline was seen in those working fulltime. The number of residents, nursing graduates, and radiologic technologists was similar to that in 2013. Laboratories used exclusively for electrophysiology were mainly operating in publicly-funded centers.

With respect to material resources, in 2014, the percentage of sites equipped with a nonfluoroscopic navigation system remained below 80%, as was the case in 2013, perhaps due to the incorporation of new, more modest centers that had fewer resources and performed less complex ablations. The availability of magnetic navigation systems was reduced in 2013 and remained at those levels at the time of data collection for the present registry.

As in previous years, there was an overall rise in the number of ablation procedures performed. However, a change was noted in the relative percentages of the various arrhythmias and arrhythmogenic substrates treated. The ablation target that, in proportion, has increased the most is AF, followed by macroreentrant atrial tachycardia. Atrial fibrillation ablation procedures increased significantly in number and, in 2014, ranked as the third most frequently performed (ahead of AP ablation), as occurred for the first time in the 2013 registry, in which AF ablation accounted for 19% of all such interventions. In 2014, the number of centers

performing more than 50 AF ablation procedures a year held steady with respect to 2013. The complications rate associated with AF ablation decreased in 2014, as was the case for the other interventions, and no deaths were reported in procedures of this type.

Point-by-point radiofrequency ablation procedures to treat AF remained stable and those performed with a cryoballoon slightly increased, from 21% to 27%, a rise that had also been reported in the 2013 registry. As in 2013, new approaches, although very few in number, have emerged, with single-shot devices such as the PVAC® (Pulmonary Vein Ablation Catheter) and new energies such as laser.

The number of ablation procedures for ventricular tachycardia in general was higher than in the 2013 registry and, in proportion, the increase in the treatment of this arrhythmia was second only to that recorded for ablation of macroreentrant atrial tachycardia. The number of ablations for idiopathic ventricular tachycardia remained stable, and the overall procedural success rate was higher than in previous years, probably related to the more widespread use of nonfluoroscopic navigation systems. There was a clear rise in the percentage of VT-ICM ablation procedures relative to 2013, which showed a 3% reduction. Targeting the substrate continued to be the most frequently used approach for this condition, at a 3:1 ratio with respect to the conventional approach. The success rate in idiopathic ventricular tachycardia was also significantly higher than in 2013. There was no significant increase in the case of the epicardial approach, which remained stable.

There were 8 deaths in 2014, twice the number reported in 2013. However, there were nearly 1000 more procedures and there was an increase in the number of centers performing which fewer ablation procedures, which could favor the development of complications. Notably, one of these deaths occurred in a patient with AVNRT.

CONCLUSIONS

Once again, as in previous years, the Spanish Catheter Ablation Registry provides one of the largest samples of ablation procedures reported to date in the international literature, compiling nearly 13 000 procedures. Increasingly more complex arrhythmias and arrhythmogenic substrates were treated, while the success rates remained very high and the percentages of major complications and deaths were low.

Yet another year, this increase in the number and complexity of the ablation procedures performed was not accompanied by an increase in the health care professionals dedicated to this activity.

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CONFLICTS OF INTEREST

None declared.

APPENDIX 1. REGISTRY COLLABORATORS

Miguel A. Arias, Javier Pindado, Julio Martí, Andrés Bodegas, M. Carmen Expósito-Pineda, José Moreno-Arribas, Eloy Domínguez-Mafé, José Manuel Rubio-Campal, Xavier Sabaté, Thomas Brouzet, Javier Jiménez-Díaz, Adolfo Fontenla, Federico Segura, Víctor Castro, Mar González-Vasserot, Bieito Campos, Rodrigo Trallero, Nicasio Pérez-Castellano, Óscar Alcalde-Rodríguez, Pilar Cabanas-Grandío, Nuria Rivas-Gándara, Juan Carlos Rodríguez-Pérez, Javier Martínez-Basterra, Santiago Magnani, Antonio Asso, José Luis Ibáñez-Criado, Javier Jiménez-Bello, Jordi Punti-Sala, Rafael Romero-Garrido, Javier Moreno, Roberto Matía, Alfonso Macías, Ángel Grande, Javier Jiménez Candil, Manuel Doblado-Calatrava, Eduardo Arana-Rueda, Miguel Álvarez-López, Alicia Ibáñez-Criado, M. Fe Arcocha-Torres, Axel Sarrias, Jerónimo Rubio, Antonio Peláez, Agustín Pastor, Ignacio Gil-Ortega, Gregoria Sarquella-Brugada, Lucas Cano-Calabria, Joaquín Osca, Javier Fosch, José Manuel Rubín, José María Guerra, Arcadio García-Alberola, Eduardo Caballero-Dorta, Ivo Roca-Luque, Antonio Linde, Ernesto Díaz-Infante, Rafael Peinado, Dolores García-Medina, Jordi Pérez-Rodón, Alberto Barrera, Concepción Alonso, Sonia Ibars, Xavier Viñolas, Enrique Rodríguez-Font, Marta Ortega-Molina, Ángel Moya-i-Mitjans, Lluís Mont, Rafael Romero, Felipe Rodríguez-Entem, Javier García-Fernández, Luisa Pérez-Álvarez, Benito Herreros, Ángel Arenal, Pablo Moriña, Amador Rubio-Caballero, José Luis Martínez-Sande, Francisco Mazuelos, Jesús Almendral, Ángel Martínez-Brotons, Ángel Ferrero-de-Loma, and M. Luisa Fidalgo

APPENDIX 2. ELECTROPHYSIOLOGY LABORATORIES PARTICIPATING IN THE 2014 SPANISH CATHETER ABLATION REGISTRY BY AUTONOMOUS COMMUNITY AND PROVINCE (IN PARENTHESES, THE PHYSICIAN IN CHARGE OF THE REGISTRY)

<i>Andalusia</i>	
Cádiz	Hospital Puerta del Mar (L. Cano Calabria)
Córdoba	Hospital Reina Sofía (F. Mazuelos)
Granada	Hospital Inmaculada Granada (M. Álvarez); Hospital Virgen de las Nieves (M. Álvarez)
Huelva	Hospital Costa de la Luz (P. Moriña); Hospital Juan Ramón Jiménez (P. Moriña)
Jaén	Complejo Hospitalario de Jaén (A. Linde)
Málaga	Hospital Quirón Málaga (M. Álvarez); Hospital Virgen de la Victoria (A. Barrera)
Seville	Hospital Nisa Aljarafe (E. Díaz Infante); Hospital Virgen Macarena (E. Díaz Infante); Hospital Virgen de Valme (D. García Medina); Hospital Virgen del Rocío (E. Arana Rueda)
<i>Aragon</i>	
Zaragoza	Hospital Miguel Servet (A. Asso); Hospital Quirón Zaragoza (A. Asso); Hospital Clínico Universitario Lozano Blesa (G. Rodrigo Trallero)
<i>Principality of Asturias</i>	
<i>Balearic Islands</i>	
<i>Canary Islands</i>	
Las Palmas	Hospital Universitario Insular de Gran Canaria (F. Segura Villalobos); Hospital Santa Catalina (J.C. Rodríguez Pérez); Hospital Dr. Negrín (E. Caballero).
Santa Cruz de Tenerife	Hospital San Juan de Dios (R. Romero); Hospital Universitario Nuestra Señora de la Candelaria (R. Romero)
<i>Cantabria</i>	
<i>Castile-La-Mancha</i>	
Toledo	Hospital Virgen de la Salud (M.A. Arias); Hospital Nuestra Señora del Prado (A. Macías)
Ciudad Real	Hospital General Universitario Ciudad Real (J. Jiménez Díaz)
<i>Castile and León</i>	
Burgos	Hospital Universitario de Burgos (J. García Fernández)
Leon	Complejo Asistencial Universitario de León (M.L. Fidalgo)
Salamanca	Hospital Universitario de Salamanca (J. Jiménez Candil)
Valladolid	Hospital Clínico Universitario de Valladolid (J. Rubio); Hospital Río Hortega (B. Herreros)
<i>Catalonia</i>	
Barcelona	Hospital del Mar (J. Martí); Hospital Germans Trias i Pujol (A. Sarrias); Clínica Sagrada Família (Á. Moya); Hospital Universitario Quirón Dexeus (J. Pérez Rodón); Clínica Rotger (X. Viñolas); Hospital de la Santa Creu i Sant Pau (C. Alonso); Hospital Vall d'Hebron (N. Rivas); Hospital de Bellvitge (X. Sabaté); Clínica Teknon (E. Rodríguez Font); Hospital Clínic (L. Mont); Mútua de Terrassa (S. Ibars); Hospital San Joan de Déu (G. Sarquella Brugada); Hospital Universitario de Sabadell-Parc Taulí (J. Punti Sala); Clínica Corachan (J.M. Guerra)
Lleida	Hospital Arnau de Vilanova (B. Campos García)
<i>Valencian Community</i>	
Alicante	Hospital Universitario San Juan (J. Moreno Arribas); Hospital General Universitario de Alicante (J.L. Ibáñez); CardioRitmo Levante (A. Ibáñez); Hospital General Universitario de Elche (T. Brouzet)
Castellón	Hospital General de Castellón (E. Domínguez Mafé)
Valencia	Hospital La Fe (J. Osca); Hospital de la Ribera (J. Jiménez Bello); Hospital Dr. Peset (A. Peláez); Hospital Clínico Universitario de Valencia (Á. Martínez); Hospital Quirón (A. Ferrero)
<i>Extremadura</i>	
Badajoz	Hospital Infanta Cristina (M. Doblado)
<i>Galicia</i>	
A Coruña	Hospital Universitario de A Coruña (L. Pérez); Complejo Hospitalario Universitario de Santiago (J.L. Martínez Sande)
Vigo	Complejo Hospitalario de Vigo (P. Cabanas Grandío)

APPENDIX 2 (Continuation)

<i>Community of Madrid</i>	Fundación Jiménez Díaz (J.M. Rubio); Hospital Universitario 12 de Octubre (A. Fontenla); Hospital Gregorio Marañón (A. Arenal); Hospital Ramón y Cajal (J. Moreno); Hospital Puerta de Hierro (V. Castro); Hospital Severo Ochoa (A. Grande); Fundación Hospital Alcorcón (A. Rubio Caballero); Hospital Universitario La Paz (R. Peinado); Hospital Universitario de Getafe (A. Pastor); Hospital Clínico San Carlos (N. Pérez Castellano); Grupo Hospital Madrid (J. Almendral); Hospital Sanitas La Moraleja (R. Matía); Hospital Infantil La Paz (M. Ortega Molina)
<i>Region of Murcia</i>	Hospital Clínico Universitario Virgen de la Arrixaca (A. García Alberola); Hospital Santa Lucía-Cartagena (I. Gil-Ortega)
<i>Chartered Community of Navarre</i>	Clínica Universidad de Navarra (O. Alcalde Rodríguez); Complejo Hospitalario de Navarra (J. Martínez Basterra)
<i>Basque Country</i>	
Álava	Hospital de Cruces (A. Bodegas)
Vitoria	Hospital Txagorritxu (J. Pindado)
Vizcaya	Hospital de Basurto (M.F. Arcocha)

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