

ARRHYTHMIAS

Indications for Catheter Ablation and Results in Andalusia, Spain

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Introduction and objectives. We report the results of the first Catheter Ablation Registry of the Arrhythmia Working Group of the Andalusian Society of Cardiology (AWGASC) for 2000.

Methods. The register includes information about the ablation procedures performed in 2000, which was collected retrospectively and submitted voluntarily by four out of six cardiac electrophysiology laboratories of the AWGASC. A total of 424 patients (mean age 45 ± 18 years; 50% men) were included. Twelve patients underwent two different ablation procedures, bringing the total number of procedures to 436. The overall success rate (based on current criteria), success rate by procedure, in-hospital mortality, and major complications are reported.

Results. The type and distribution of the ablation procedures were atrioventricular nodal re-entry tachycardia ablation, 34%; accessory pathway ablation, 39%; ventricular tachycardia ablation, 8%; atrial tachycardia ablation, 3%; atrioventricular junctional ablation, 9%, and cavo-tricuspid isthmus ablation, 9%. The overall success rate was 94% (range 97.8% to 87.4% in different laboratories), rate of major complications 1.1% (range 0% to 3.7%), and overall mortality 0.23% (1 patient).

Conclusions. These findings summarize the indications and results of catheter ablation procedures performed in 2000 at four cardiac electrophysiology laboratories in Andalusia. This is the first multicenter registry in Spain.

Key words: Catheter ablation. Arrhythmias. Registries.

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Indicaciones y resultados de la ablación con catéter en Andalucía

Introducción y objetivos. Presentamos los resultados del primer registro de ablación con catéter del Grupo de Trabajo de Arritmias de la Sociedad Andaluza de Cardiología (GTASAC).

Métodos. El registro se ha realizado con los datos de la actividad del año 2000, recogidos retrospectivamente y aportados por 4 laboratorios de electrofisiología de los seis que integran el GTASAC. Incluimos a 424 pacientes (edad media 45 ± 18 años; rango, 12-81; 50% varones); en doce de ellos tratamos dos objetivos diferentes, por lo que analizamos 436 procedimientos de ablación. Hemos calculado los porcentajes de éxito global y por procedimiento (definido según criterios habituales), mortalidad y complicaciones mayores durante la fase hospitalaria.

Resultados. La distribución de los tipos de procedimiento fue la siguiente: ablación de taquicardia intranodal, 34%; ablación de vías accesorias, 39%; ablación de taquicardia ventricular, 8%; ablación de taquicardia auricular, 3%; ablación del nodo auriculoventricular, 9%, y ablación del istmo cavotricuspidé, 9%. El porcentaje global de éxito de la ablación fue del 94%; por centros, el éxito varió entre el 97,8 y el 87,4%. El porcentaje de complicaciones mayores fue del 1,1%, que varió entre el 0 y el 3,7%. La mortalidad global fue del 0,23% (1 paciente).

Conclusiones. Los datos aportados reflejan las indicaciones y resultados de la ablación con catéter durante el año 2000 en cuatro laboratorios de electrofisiología clínica cardíaca en Andalucía, y tienen el valor de constituir el primer registro multicéntrico a escala nacional.

Palabras clave: Ablación con catéter. Arritmias. Registros.

INTRODUCTION

Percutaneous radiofrequency ablation has become the treatment of choice for most tachyarrhythmias.¹ Its use not only has improved the quality of life of patients, but has done so with a high level of cost-effectiveness.² However, the possibility of potentially serious complications must be taken into consideration when establishing the indication for this therapeutic option, which requires careful assessment of candidates. The

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ABBREVIATIONS

AVN: atrioventricular node.
 INT: intranodal tachycardia.
 ACP: accessory pathway.
 VT: ventricular tachycardia.
 AT: atrial tachycardia.
 CTI: cavotricuspid isthmus.

operator's training must be adequate in order to optimize the risk-benefit ratio of treatment, a point that has been contemplated in the recommendations of the American Society of Cardiology³ and the Sociedad Española de Cardiología (Spanish Society of Cardiology)⁴ as one of the conditions that should be satisfied by cardiologists who perform ablation procedures.

Quality control of the activities of each electrophysiology laboratory is only possible by comparing results with those of published multicenter registries. Nevertheless, it is necessary to consider that each electrophysiology laboratory has its own characteristics, to a large extent conditioned by its setting, and comparison of its results with standards obtained in other settings can be fallacious. In Spain, there is a deficit in this sense because, although we have had annual multicenter registries for different cardiological techniques for years, none has included percutaneous catheter ablation.

In 2000 we constituted the Arrhythmias Working Group within the Andalusian Society of Cardiology (Sociedad Andaluza de Cardiología), one of the objectives of which is the preparation of annual registries of the activities of all the affiliated electrophysiology laboratories.

METHODS

Hospital centers

Four of the six electrophysiology laboratories affiliated with the Arrhythmias Working Group of the Andalusian Society of Cardiology (Hospital Virgen del Rocío and Hospital de Valme of Seville, Hospital Virgen de la Victoria of Málaga and Hospital Virgen de las Nieves of Granada) have voluntarily contributed all the data required on the indications and results of the ablation procedures performed in 2000.

Each center is staffed by two specialists per laboratory, who work full-time in three of the laboratories. The nursing personnel are shared in two laboratories and full-time in another two. Only one laboratory has two nurses.

Two centers have a full-time electrophysiology laboratory. One shares space with the Hemodynamics Unit

and performs ablations four days a week. The other one shares space with the Pacemaker Unit of the hospital and performs ablations two days a week. Three laboratories have the computerized cardiac mapping system Labsystem of the Bard Company and one has the Hellige Midas polygraph. None of the four laboratories has a nonfluoroscopic intracardiac navigation system.

Patients

In this first registry we analyzed the results by study subject. In 412 patients we examined a single objective (analyzed as one procedure per patient) and in 12 patients we examined two different objectives, resulting in 436 procedures in 424 patients.

Procedures

The definition of success for each ablation procedure was similar to that established in international scientific references: *a*) bidirectional block in ablation of the cavotricuspid isthmus (CTI); *b*) induction of a maximum of two echoes in the case of intranodal tachycardia (INT); *c*) suppression of conduction by the accessory pathway (ACP); *d*) non-reinduction of treated ventricular tachycardia (VT) or atrial tachycardia (AT), and *e*) complete AV block, in the case of ablation of the atrioventricular node (AVN). The time lapse from the last radiofrequency application to the moment in which the process is considered to have been successful is routinely determined in each laboratory (30 min). The ACP were located following the nomenclature proposed by the Arrhythmias Working Group of the European Society of Cardiology.⁵

We calculated separately the mortality rate and the rate of major intrahospital complications: acute myocardial infarction, cardiac tamponade, severe pericardial effusion, cerebrovascular accident, unintentional complete AV block, pulmonary thromboembolism, and surgical repair of vascular complications.

In this first registry, the incidence of recurrences in outpatient clinical follow-up was not analyzed.

Statistical analysis

Data are expressed as mean±standard deviation (SD). The qualitative variables were analyzed by means of the χ^2 test and the Fisher exact test if the sample size was small. The quantitative variables were analyzed by means of the Student *t* test. The ages of patients were compared by center and procedure using analysis of variance. Each center was assigned a letter (A, B, C, and D) anonymously, which is repeated in all the comparisons. A value of $P < .05$ was considered statistically significant. The statistical analysis was made with the SPSS 9.0 program.

RESULTS

Demographic characteristics

The mean age of the 45 patients was ± 18 years (range, 12-81 years). Patients with ACP had an age similar to that of the patients with AT and significantly younger than the other patients. Half of the patients were women. AVN, AT and INT ablation procedures were performed more frequently in women, whereas CTI and VT ablation was more frequent in men. There was no clear predominance of sex in the patients with ACP. When comparing centers there were no significant differences in sex or in the age of patients (Table 1).

Structural heart disease was present only in the cases of VT ablation, occurring in 53% (n=18) of these cases. The heart diseases observed were ischemic heart disease (n=13); dilated cardiomyopathy (n=2); cardiac valve disease (n=1); arrhythmogenic dysplasia of the right ventricle (n=1), and double-chamber right ventricle (n=1).

Indications and types of procedures

The most frequent indication (39%) was ACP (including cases of pre-excitation and hidden pathways). Paroxysmal tachycardias related to INT motivated 33% of the indications. Flutter and AT constituted 10%, atrial fibrillation, 9%, and VT, 8%.

The number of ablation procedures carried out was 436. The number of procedures per center was 146 in center A, 136 in center B, 103 in center C, and 54 in center D.

In the four centers, the INT and ACP ablation procedures predominated. In three centers these procedures were performed in more than 60% and in one (center D) it was performed in more than 90% (Table 2).

Most (92.6%) of the procedures were performed with 4-mm catheters. Of the 36 CTI ablation procedures done, 25 were done with 8-mm catheters and three with irrigated-tip catheters. Of the 35 VT ablation procedures done, 4 were done with irrigated-tip catheters. One accessory pathway ablation procedure was done with an irrigated-tip catheter.

Overall results

The overall success rate of the ablation was 93.6%. By procedures, the success rate was over 90% in INT and ACP, over 80% in AT and VT without heart disease, and over 75% in CTI and VT with heart disease (Table 3). The success rate was more than 90% in three of the four centers (Table 3), being significantly greater in center B (97.8%) than in center C (87.4%) ($P < .05$).

The percentage of major complications was 1.1% (5 patients) (Table 3). Two patients presented AV block;

TABLE 1. Mean age and sex depending on type of procedure and center

	Age (range)	Men n (%)	Women n (%)
Procedures			
AVN ablation	63 \pm 12 (26-81)	15 (35.7)	27 (64.3)
INT ablation	46 \pm 16 (13-79)	52 (36.6)	90 (63.4)
ACP ablation	35 \pm 15 (12-77)	88 (56.1)	69 (43.9)
AT ablation	36 \pm 17 (12-67)	2 (15.4)	11 (84.6)
CTI ablation	57 \pm 14 (23-81)	29 (80.6)	7 (19.4)
VT ablation (total)	56 \pm 15 (22-75)	26 (74.3)	8 (25.7)
Heart disease	61 \pm 11 (43-75)	16 (88.9)	2 (11.1)
No heart disease	50 \pm 17 (22-72)	10 (62.5)	6 (37.5)
Center			
A	44 \pm 18 (12-81)	71 (49.7)	72 (50.3)
B	47 \pm 19 (12-81)	64 (49.2)	66 (50.8)
C	45 \pm 17 (12-78)	55 (55)	45 (45)
D	45 \pm 15 (18-76)	22 (43.1)	29 (56.9)
Total	45 \pm 18	212 (50%)	212 (50%)

CTI indicates cavotricuspid isthmus; AVN, atrioventricular node; AT, atrial tachycardia; INT, intranodal tachycardia; VT, ventricular tachycardia; ACP, accessory pathway.

TABLE 2. Number and type of procedures by center

Procedure	A n (%)	B n (%)	C n (%)	D n (%)
AVN ablation	16 (11.2)	20 (14.7)	4 (3.9)	3 (5.6)
INT ablation	48 (33.6)	43 (31.6)	27 (26.2)	26 (48.1)
ACP ablation	49 (34.3)	54 (39.7)	38 (36.9)	23 (42.6)
AT ablation	4 (2.8)	3 (2.2)	7 (6.8)	0
CTI ablation	15 (10.5)	8 (5.9)	12 (11.7)	1 (1.9)
VT ablation (total)	11 (7.7)	8 (5.9)	15 (14.6)	1 (1.9)
Heart disease	7 (4.9)	5 (3.7)	7 (6.8)	0
No heart disease	4 (2.8)	3 (2.2)	8 (7.8)	1 (1.9)
Total	143 (100)	136 (100)	103 (100)	54 (100)

CTI indicates cavotricuspid isthmus; AVN, atrioventricular node; AT, atrial tachycardia; INT, intranodal tachycardia; VT, ventricular tachycardia; ACP, accessory pathway.

2, severe pericardial effusion, and 1 patient suffered pulmonary embolism.

The analysis of complications by center (Table 4) showed that center D (with the smallest caseload) had a complication rate of 3.7%, which was higher than that of the other centers. A trend ($P = .06$) was observed in the rate of complications in this center compared with the percentage of complications (0.8%) of the other centers, which performed more than 100 procedures a year.

The mortality rate was 0.23% (1/424 patients). The only death was a patient with previous anterior infarction, ejection fraction (EF) < 30%, who had an implantable defibrillator which was indicated after ablation proved ineffective. This patient was later readmitted with incessant VT and severe hemodynamic impair-

TABLE 3. Number of procedures, success rate, and major complications depending on type of procedure

Procedure	n (%)	Success n (%)	Complications n (%)
AVN ablation	43 (9.9)	42 (97.7)	1 (2.3)
INT ablation	144 (33)	142 (98.6)	2 (1.4)
ACP ablation	164 (37.6)	155 (94.5)	2 (1.2)
AT ablation	14 (3.2)	12 (86)	0
CTI ablation	36 (8.3)	28 (77.8)	0
VT ablation (total)	35 (8.1)	29 (83)	0
Heart disease	19 (4.4)	15 (78.9)	0
No heart disease	16 (3.7)	14 (87.5)	0
Total	436 (100)	28 (93.6)	5 (1.1)

CTI indicates cavotricuspid isthmus; AVN, atrioventricular node; AT, atrial tachycardia; INT, intranodal tachycardia; VT, ventricular tachycardia; ACP, accessory pathway.

ment; after a new ablation procedure proved ineffective, the patient died in the Intensive Care Unit 20 days later from causes not directly related with VT.

Results based on type of procedure (Tables 2 and 3)

Intranodal tachycardia

One hundred forty-four procedures were performed. A slow pathway was treated in 142 cases (98.6%) and a fast pathway in 2 (1.4%). Success was achieved in 142 patients (98.6%). Two (1.4%) patients suffered AV block that made implantation of a definitive pacemaker necessary.

Accessory pathways

One hundred sixty-four procedures were performed. Eighty-eight (53.7%) left ACP (69 posterior and 19 inferior), 59 (36%) septal ACP (39 inferoparaseptal, 14 superoparaseptal, and 6 septal), and 18 (10.3%) right ACP (11 anterior, 5 superior, and 1 inferior) were treated. We achieved success in 155 procedures (94.5%) with a complication rate of 1.2%. One patient suffered a pulmonary embolism and another one, severe peri-

cardial effusion. The rate of success varied slightly (without reaching statistical significance) depending on the target ACP: 96.6% in left appendage, 89.8% septal, and 100% in right pathways.

AVN ablation

Forty-three procedures were performed. The arrhythmia that motivated this procedure was atrial fibrillation in 39 cases (90.7%), common flutter in 2 cases and atypical flutter in another two. AV block was achieved in 42 procedures (97.7%), with severe pericardial effusion in one case (2.3%).

CTI ablation

Thirty-six procedures were carried out. The procedure was successful in 77.8% (n=28) of the cases, with no major complication.

Atrial tachycardia

Fourteen procedures were performed. In 3 cases the procedure involved the left atrium and in 11, the right atrium. The procedure was successful in 86% (n=12) of cases, with no major complication.

Ventricular tachycardia

Thirty-five procedures were carried out. The left ventricle was treated in 73.6% (14/19) of the patients with heart disease and in 50% (8/16) of the patients without heart disease. The right ventricle was treated in 26.4% of the patients with heart disease and in 50% of the patients without heart disease. The overall success rate was 83% (n=29), where 79% of the cases occurred in the presence of heart disease and 87.5% without heart disease. In the cases of VT produced by a postinfarction scar, the success rate was 86% and the result was successful in the 3 cases in which VT was due to branch-branch reentry. The procedure had a negative result in one patient with arrhythmogenic dysplasia of the right ventricle and in another one with double-chamber right ventricle. The success rate in

TABLE 4. Success rate, major complications (436 procedures) and mortality (424 patients) by center

	A n (%)	B n (%)	C n (%)	D n (%)	Total n (%)
Overall success	135 (94.4)	133 (97.8)	90 (87.4)	50 (92.6)	428 (93.6)
Complications	2 (1.39)	1 (0.73)	0	2 (3.7)	5 (1.1)
AVB	0	1	0	1	2 (0.45)
Severe PE	1	0	0	1	2 (0.45)
PTE	1	0	0	0	1 (0.22)
Mortality	0	0	1 (0.97)	0	1 (0.23)

AVB indicates atrioventricular block; PE, pericardial effusion; PTE, pulmonary thromboembolism.

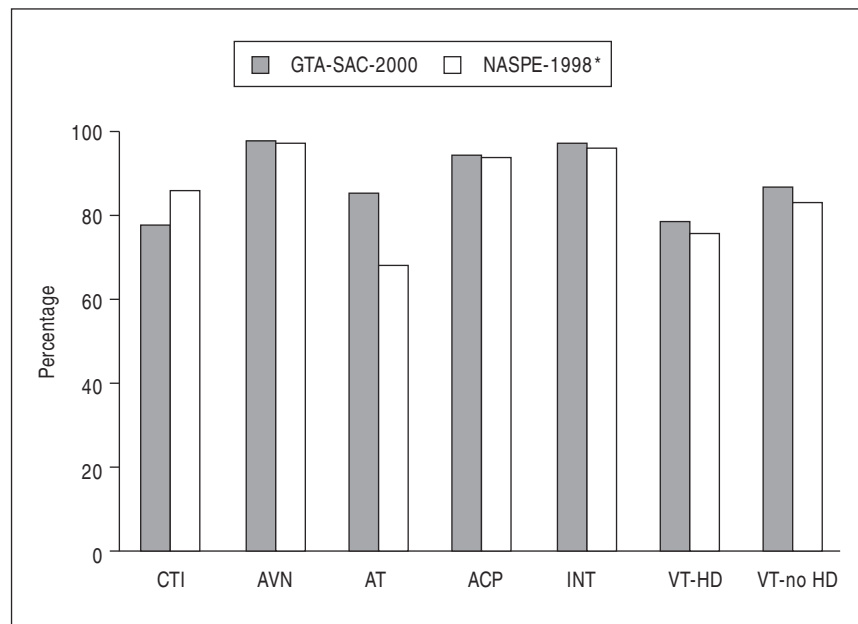


Fig. 1. Comparison of the success rate of each ablation procedure between the Arrhythmias Working Group of the Andalusian Society of Cardiology (AWG-ASC) in 2000 and the NASPE Registry in 1998 (*values were collected from information contained in the article). CTI indicates cavotricuspid isthmus; AVN, atrioventricular node; AT, atrial tachycardia; INT, intranodal tachycardia; VT-HD, ventricular tachycardia and heart disease; VT-no HD, ventricular tachycardia without heart disease; ACP, accessory pathway.

idiopathic VT was identical (87.5%) in the cases of VT of the RV outflow tract and in the cases of left ventricular VT.

DISCUSSION

The activity shown here includes all the consecutive ablation procedures performed in four cardiac electrophysiology laboratories of Andalusia in 2000, out of six affiliated with the Arrhythmias Working Group of the Andalusian Society of Cardiology. To our knowledge, this is the first multicenter ablation registry to be carried out in Spain and it thus has reference value for providing information on the indications, results, and complications of catheter ablation collected in several centers in a similar setting.

Although the usefulness and/or need for a multicenter registry is a topic of discussion, knowledge of the activity of different electrophysiology laboratories in a common setting contributes to providing an image of the clinical reality of ablation, a reality that probably is not illustrated when results are obtained only from a single electrophysiology laboratory or a specific arrhythmia. On the other hand, registries allow a larger number of patients to be entered in a short time period (generally a year), thus providing a view of the present status of the technique and avoiding the temporary bias of evolution and changes in technology, indications, criteria for success, or modifications in the treatment of a given arrhythmia. For these reasons, registry data reflect more faithfully the reality of contemporary daily practice.

Several registries⁶⁻⁹ have been published since ablation became the treatment of choice in cardiac arrhythmias. The registry most recently published and of great

importance, both with regard to the number of participating centers and the number of patients included, is that of the North American Society of Pacing and Electrophysiology (NASPE). This registry began in 1998 and was published in 2000.⁷ The comparison of our results with those obtained in this registry, evidently much more numerous but less representative (see below), generally showed little difference in the analysis of the success rate by type of arrhythmia (Figure 1). There is a close similarity in the success rates of the AVN, INT, and ACP ablation procedures, fully coinciding with those published by Calkins et al¹⁰ in a prospective multicenter study. The results for other types of arrhythmia do not differ much between the two registries (Figure 1).

The number of procedures performed per center and operator is suitable according to different guidelines for competency in ablation. Thus, the NASPE in 1992 recommended the realization of 30 or more ablation procedures as the first operator during the learning period.¹¹ It has also been recommended that 21 to 50 procedures be carried out yearly to maintain competency.³ In our case, each of the two operators in each laboratory performed from 27 to 71 procedures.

We cannot know exactly how many ablations per million inhabitants are performed in our community, since only four centers communicated their results. A figure from a nearby country is 456 ablations carried out in Portugal in 1999 (in nine centers, two of them with more than 100 procedures).⁶ Comparison with the NASPE data⁷ is not possible since only 68 of 950 centers (7%) to which the survey was sent answered the registry.

Most of the arrhythmias treated in our laboratories were INT and arrhythmias associated with ACP, where

the percentage of atrial arrhythmias (flutter, tachycardia, and fibrillation) and ventricular tachycardias in patients with structural heart disease was low, a circumstance also observed in Portugal.⁶ Likewise, a high percentage of patients (46%) with idiopathic VT was found in the group of patients with VT (as in the NASPE registry).⁷ Among the possible causes that can explain the scant presence of arrhythmias with more complex substrates (atrial fibrillation and VT with heart disease) is the technological deficit implicit in not having nonfluoroscopic intracardiac navigation systems.¹²

In general, there are few variations in the success rate between the four centers, where the lower success rate of one of them was due to the greater complexity of the procedures performed at the center (Table 2). As far as the rate of complications is concerned, one center had a higher percentage than the others (3.7%); it was also the center that carried out the smallest number of procedures (n=54). Both circumstances (similar success rates and differences in the complication rate in relation to the number of procedures) have been described in previous registries. In particular, in the NASPE Registry⁷ of 1998 there were no significant differences with regard to the success rate of centers with more and less than 100 procedures. In the MERFS study the complication rate was higher in centers with less experience.^{13,14} This circumstance must be considered when establishing ablation indications and the clinical presentation of each specific arrhythmia must be evaluated.

The rates of major complications found (1.1%) were clearly lower than those published in the MERFS registry¹⁵ and slightly lower than the NASPE registry⁷ and the study of Calkins et al.¹⁰ In the Portugal registry,⁶ the complications are not referred to (nor the success rate). In particular, the rate of AV block in INT is 1.4%, similar to that of the study by Calkins et al.¹⁰ and the rate reported in the NASPE Registry⁷ (1.3% and 1%, respectively), and clearly lower than that of the MERFS registry.¹³ The absence of serious vascular complications must be emphasized.

The absence of mortality in patients without heart disease and in patients with supraventricular arrhythmias is noteworthy, although to be expected given the good prognosis of this group of patients.

Limitations

As in all voluntary registers, the results cannot be extrapolated to all the centers in the geographic area targeted. However, 4 of the 6 laboratories affiliated with the Arrhythmias Working Group of the Andalusian Society of Cardiology contributed data to this registry. Therefore, we think that it could be representative of average activity in Spain at present, where most centers lack nonfluoroscopic intracardiac navigation systems, and it provides the first references.

tion systems, and it provides the first references.

One of the aims of our Working Group is to record all the ablation procedures in our community. Nevertheless, the fact that there are two centers where ablation procedures are performed in units not affiliated with cardiology departments makes it difficult to attain that objective. We do not know if this circumstance has an influence on whether or not the indications conform to the recommendations of scientific cardiology organizations.¹⁵⁻¹⁷

Data collection was retrospective, and the different databases of each center were combined, which is why some data that could have been of interest was not collected. The clinical outcome of the patients was not entered because this is evaluated on an outpatient basis at each center. Both of these circumstances should be resolved for upcoming registers.

CONCLUSIONS

The national data are the first reference of a registry of the indications and results (success and complications) of ablation procedures prepared by several electrophysiology laboratories. The first registry also demonstrated the similarity of the success rate of ablation in different electrophysiology laboratories in the same setting, as well as the scant difference with respect to registries in other countries. On the other hand, the registry provides information suggesting that there may be a greater percentage of complications in laboratories that perform fewer procedures.

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