Spanish Cardiac Catheterization and Coronary Intervention Registry. Sixteenth Official Report of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology (1990–2006)

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This article summarizes the data reported to the 2006 registry of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology. Data were obtained from 135 centers. Of these, 125 performed catheterizations mainly in adults, while 10 carried out procedures in pediatric patients only.

In 2006, 126 196 diagnostic catheterizations were carried out. Of these, 113 228 were coronary angiograms, 7.6% more than in 2005. The population-adjusted rate was 2560 coronary angiograms per million inhabitants. A total of 57 041 percutaneous coronary interventions were performed, which was 7.8% more than in the previous year and which corresponds to a rate of 1293 per million inhabitants. Stents were used in 96.1% of coronary interventions. Overall, 90 006 stents were implanted, of which 59.3% were drug-eluting stents. Moreover, 10 067 interventions were carried out for acute myocardial infarction, 20.6% more than in 2005 and accounting for 17.6% of all percutaneous coronary interventions.

Non-coronary interventions were most frequently performed for adult congenital heart disease, with closure of an atrial septal defect being the most numerous, at 334 procedures. Percutaneous mitral valvuloplasties were performed in 431 cases, a similar figure to that recorded in the previous registry, and the success rate was 93.6%.

Each year, radial access continues to be used more frequently for coronary procedures.

Finally, it is important to emphasize that a high percentage of laboratories reported results, which ensures that the data presented here can serve as an international reference source for percutaneous cardiac interventions performed in Spain.

Key words: *Registry. Catheterization. Coronary angiography. Coronary angioplasty. Stent.*

Registro Español de Hemodinámica y Cardiología Intervencionista. XVI Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (1990-2006)

Se presentan los resultados del Registro de Actividad de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología del año 2006. Se recogen los datos de 135 hospitales, de los cuales 125 realizan su actividad predominante en adultos y 10 atienden exclusivamente a pacientes pediátricos.

Se realizaron 126.196 estudios diagnósticos, con 113.228 coronariografías, lo que representa un aumento del 7,6% respecto al año 2005 y una tasa de 2.560 coronariografías/millón de habitantes. Se realizaron 57.041 procedimientos intervencionistas coronarios, con un incremento del 7,8% respecto al 2005 y una tasa de 1.293 intervenciones/millón de habitantes. Se implantaron 90.006 *stents,* de los cuales el 59,3% fueron farmacoactivos. Se llevaron a cabo 10.067 procedimientos de intervencionismo en el infarto agudo de miocardio, lo que supone un incremento del 20,6% respecto al año anterior y representa el 17,6% del total de las intervenciones coronarias percutáneas.

El intervencionismo no coronario más frecuente se realiza en las cardiopatías congénitas del adulto, como el cierre de la comunicación interauricular, que es el de mayor número, 334 procedimientos. La valvuloplastia mitral, con 431 casos tratados, apenas presenta cambios respecto al anterior Registro, y su éxito está en el 93,6%.

La vía de acceso radial se usa cada vez más y mantiene el aumento de años anteriores.

Es de destacar el alto grado de participación de los diferentes centros en el actual Registro, que hace que sea un referente internacional de la actividad hemodinámica en nuestro país.

Palabras clave: *Registro. Cateterismo cardiaco. Coronariografía. Angioplastia coronaria.* Stent.

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ABBREVIATIONS

AR: autonomous regions
AMI: acute myocardial infarction
DES: drug-eluting stent
LMCA: left main coronary artery
PCI: percutaneous coronary intervention

INTRODUCTION

Catheterization is one of the medical specialties that has seen most progression in recent years, providing patients and society with an invaluable service. This continuous development of new techniques should be subject to appropriate quality control. Therefore, assessment of the procedures and outcomes is something that can help us get a better grasp of the realities and quality in our clinical practice. Since 1990, the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology has aimed to collect and analyze data from Spanish centers that undertake catheterization procedures, with a trend towards better data collection each year.[1-15] The collection and analysis of this information is a clear reflection of the interest of the scientific community associated with interventional cardiology has in bettering itself. This article summarizes the data which correspond to procedures in 2006 and which were presented in the Annual Meeting of the Working Group on Cardiac Catheterization and Interventional Cardiology.

The level of information obtained provides, on the one hand, knowledge of the situation in Spain and how it relates to international experience and, on the other, allows assessment of the development of interventional cardiology in the different autonomous regions of Spain. The free availability of these data favors knowledge of the distribution of resources and evaluation of the different tendencies of use and the frequency of diagnostic and therapeutic procedures.

This study analyses the 16th report of catheterization procedures in Spain which covers the activity of most of the centers in both the public and private sectors.

METHODS

Data collection was done using a common questionnaire (Appendix 1), which was made available to all catheterization laboratories in Spain by 2 routes. The first route was by means of the webpage of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology (http://www.hemodinamica.com) with an online form. Use of this route is growing and it seems the most appropriate approach both for the current board of the working group and for previous boards. Data were also collected "traditionally," that is, manually filling out the same form (on hardcopy). The company Izasa was responsible for distributing and collecting this form. For 2006, 78 centers filled out the online form (58% of the countrywide total). The analysis of the information obtained was done by the management board of the working group and is made public in this article.

The population calculations, both for the country as a whole and for each autonomous region, were done based on the population estimations of the Spanish National Institute of Statistics for January 1, 2007, and published on their website (http://www.ine.es). Spain was estimated to have a population of 44 708 964 inhabitants in 2006.

As in previous registries, public hospitals were taken to be those which, regardless of where they obtained funding from, consistently attended a certain section of the population within the public health system. The remaining hospitals were considered as private.

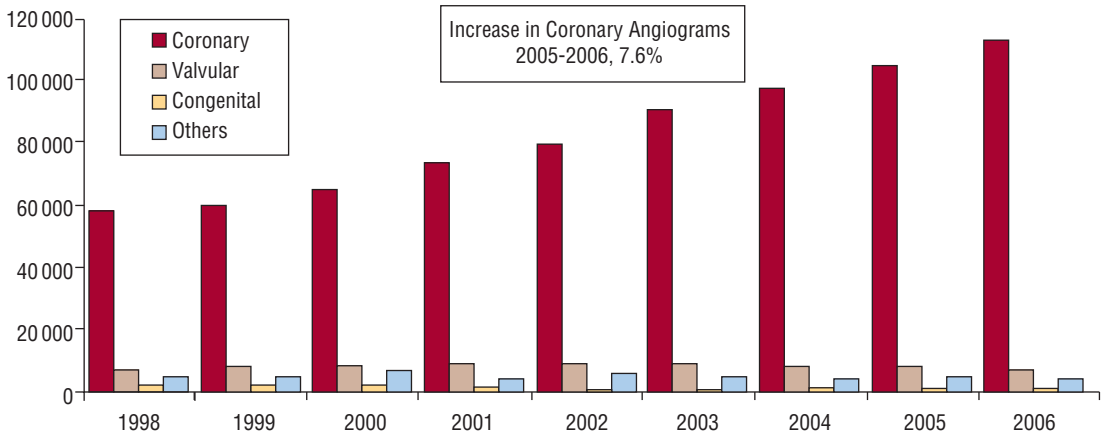
RESULTS

Infrastructure and Resources

One hundred and thirty-five hospitals (Appendix 2) carrying out catheterization procedures participated in the registry. Of these, 125 centers carried out procedures mainly in adult patients and 18 also admitted pediatric patients. Ten hospitals carried out procedures in pediatric patients only. All 74 public centers that performed interventional activity in Spain sent in data. Fifty-one private centers also provided data. This represents 97% of centers carrying out interventional activity in Spain.

Hospitals for Adults

In the 125 centers that carried out interventional procedures primarily in adults, 171 catheterization laboratories were available and, of these, 158 were computerized (92%). The number of hospitals and laboratories worked out at 2.8 and 3.82, respectively, per million inhabitants. Two or more catheterization laboratories were available in 41 centers. Of the total number of centers, 51 (41%) were private and 74 (59%) formed part of the public health system. This represents 99% of centers carrying out catheterization procedures, whether diagnostic or interventional, in Spain. An emergency team was on standby 24 hours a day in 62% of the centers (66% of the public centers and 34% of the private ones). Heart surgery was available in 66% of the centers (n=83)—the remaining 39 centers had no such facilities. For 122 centers, 397 cardiologists were dedicated to catheterization procedures (3.25/center, 8.8 specialists per million inhabitants). The figures reflect a gradual increase in the number of specialists in Spain (8.01 in 2004 and 8.3 in 2005). With regard to nursing staff, 123 centers provided data. There were 486 registered nurses and 107 radiology technicians, which worked out



Coronary	59 321	65 234	73 382	79 607	83 667	90 939	97 785	103 646	113 228
Valvular	8084	8426	9532	9452	8225	9168	8738	7978	7901
Congenital	2094	2248	531	1328	570	613	701	721	741
Others	4865	6897	5840	4097	5027	5228	4227	4900	3923
Total	74 364	82 805	95 430	88 339	97 609	105 939	111 451	117 245	126 196

Figure 1. Change in the number and type of diagnostic procedure done between 1998 and 2006.

at 4.8 nurses or technicians per center and 3.5 per laboratory.

Pediatric Hospitals

Ten of the centers included in the registry reported treating pediatric patients only, with 10 laboratories (all of which were computerized). These laboratories had 2.1 specialists per center and all performed catheterization procedures.

Diagnostic Procedures

During 2006, 126 196 diagnostic studies were undertaken, representing a 7.6% increase over 2005; this increase is only exceeded by the one from 2002-2003 (8.5%). In 2003-2004, it was 5.2% and in 2004-2005, it was 5.1%. Of these procedures, 113 228 were coronary angiograms, corresponding to an increase of 7.6%. The annual growth was only greater in 2002-2003 (8.6%).[13] In Europe, the increase in 2004-2005 was 2.7% (personal communication from Dr Bernhard Meier, "Percutaneous coronary interventions in Europe in 2005"). Overall, 21.7% of the coronary angiograms were performed in women and 19.1% in patients over 75 years of age.

In total, 2569 coronary angiograms/million inhabitants were performed, a figure which is still below the European average of 4030 coronary angiograms/million population for 2005 (personal communication from Dr Bernhard Meier).

Figure 1 shows the distribution of all diagnostic procedures. The progressive increase in the number of coronary angiograms is the only one that is maintained over the last 8 years; the number of studies done in patients with congenital heart diseases and catheterization studies of heart valves shows a tendency to level off after a progressive decrease in previous years.

As in 2005, during 2006, 48 centers performed more than 1000 coronary angiograms and 11 more than 2000, which represents 39.7% and 9%, respectively, of the total centers with data available. On the other hand, 47 centers performed fewer than 500 coronary angiograms and 6 of these belonged to the public health sector (Figure 2). A mean of 1009 diagnostic procedures were performed per center and 737 per laboratory—this does not represent any substantial changes with respect to the 2 previous registries.[14,15] Likewise, there were no changes in the public health sector, where 946 procedures were performed per laboratory compared to 950 in 2005. The number of studies per center increased with respect to the previous year to 905 in 2006. In the breakdown by sector, 1278 coronary angiograms/center were done in the public sector compared to 341 per center in the private sector.

In 2006, the differences in the number of coronary angiograms per million inhabitants among the different Spanish autonomous regions had tended to even out, and the range of coronary angiograms/million inhabitants obtained was 977, which corresponds to a decrease of 467 studies compared to 2005 and shows a tendency towards a more even distribution of the diagnostic

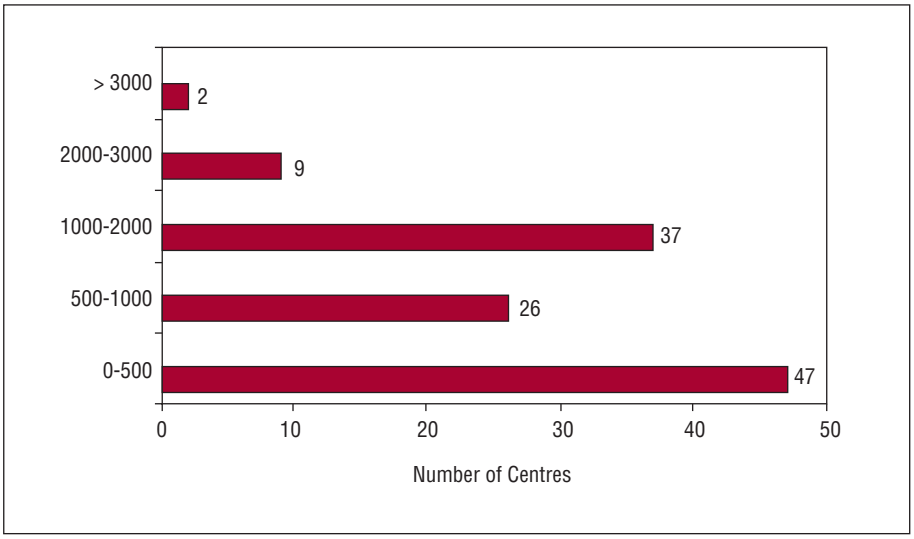


Figure 2. Distribution of centers according to the number of coronary angiograms performed.

procedures. Figure 3 shows the data by Spanish autonomous regions.

With regard to the intracoronary diagnostic techniques, pressure wires and intravascular ultrasound are still the most widely used. Of note is the increase in the use of both compared to the previous year. This increase is 30.6% (3750 procedures) in the case of ultrasound and 15.3% in the case of pressure wires (1312 procedures). The use of intracoronary Doppler flow guidewires continues to decrease, and in 2006 only 35 such procedures were done (51 procedures in 2005). Of the other diagnostic techniques, all used relatively infrequently, of note is optical coherence tomography, endothelial function studies, thermography, and intracardiac ultrasound studies. Figure 4 shows the changes in the usage of the different intracoronary diagnostic techniques in recent years.

The femoral artery is still the preferred approach route for Spanish catheterization specialists, but the increase in the use of the radial artery seen in previous years continued and in 2006, 38.1% of the diagnostic procedures used this approach route.

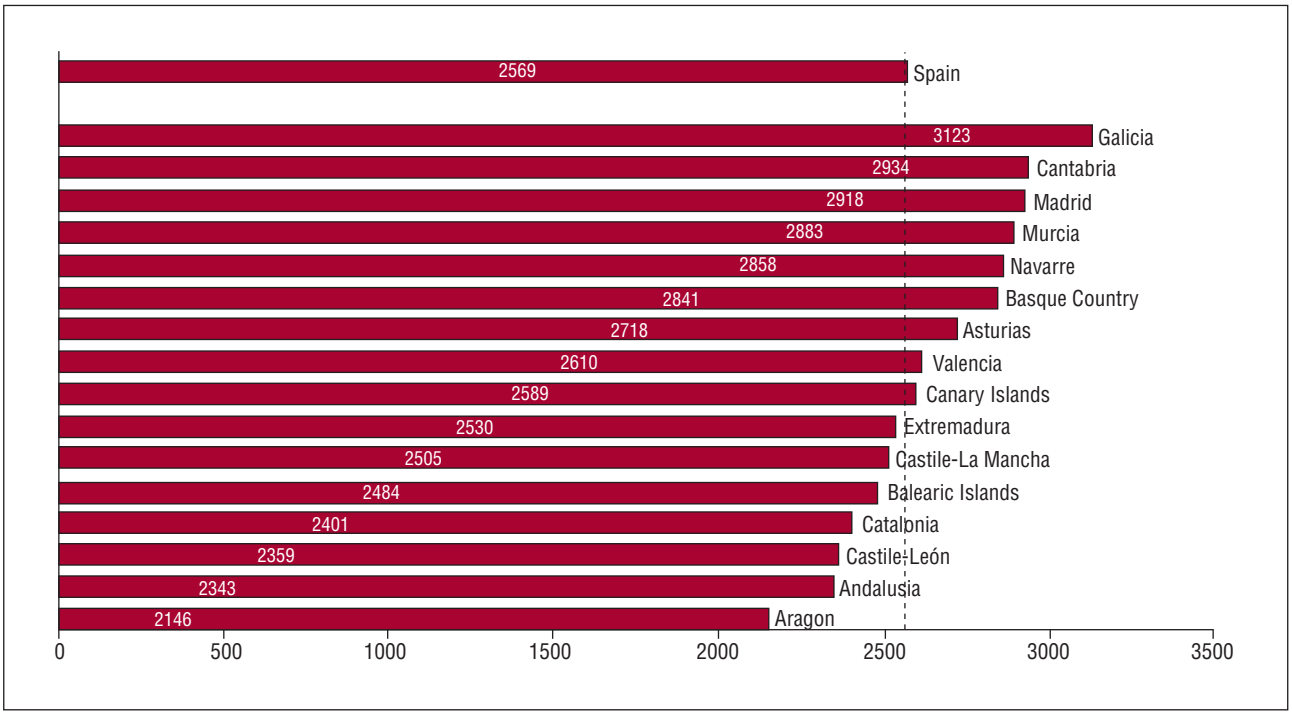


Figure 3. Distribution of coronary angiograms per million inhabitants by autonomous region.

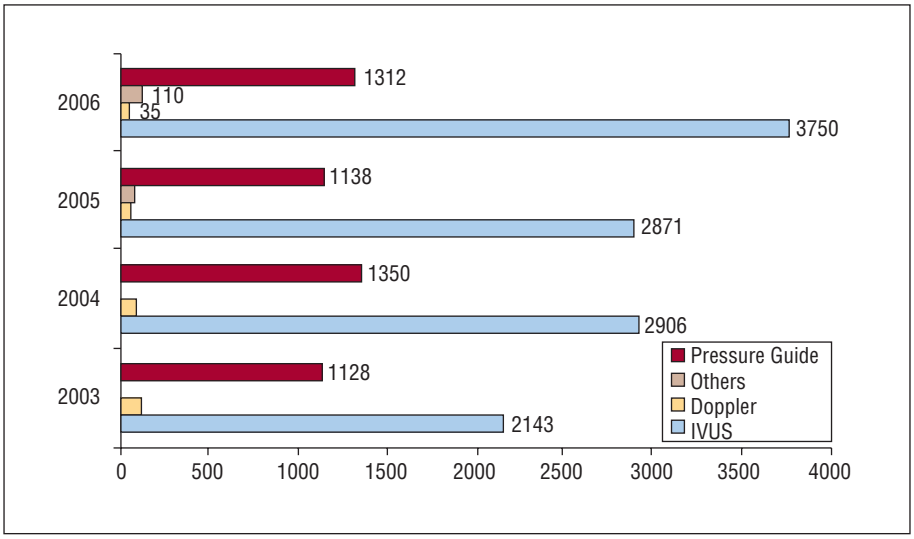


Figure 4. Change in the different intracoronary diagnostic techniques.

The hospitals that treat pediatric patients reported performing 1016 diagnostic procedures, of which 71 were endomyocardial biopsies.

Percutaneous Coronary Intervention

During 2006, 57 041 PCI were done, an increase of 7.8% compared to the previous year. This increase was less than the 13.1% increase reported between 2004 and 2005. The changes over time in PCI in Spain in the last 10 years are presented in Figure 5. The number of PCI/million inhabitants was 1293 in all of Spain, that is, less than the 1601 procedures/million inhabitants for the European data for 2005, although the increase with respect to 2004 was just 3.1% (personal communication from Dr Bernhard Meier). The mean number of procedures PCI undertaken was 463 per center and 333 per laboratory. The annual number of PCI procedures per operator was 161. For public sector hospitals, the mean number of PCI was 66 procedures per hospital, 442 per laboratory, and 209 per operator, corresponding to increases of 8%, 5%, and 9%, respectively, compared to 2005.

The percentage of PCI/coronary angiograms was 50.4% in 2006, and so continues the increasing trend seen in recent years and reflects an increase in the number of complex cases treated by PCI. The number of procedures for multivessel disease was 15 971 (28% of all PCI procedures), with no substantial changes with respect to the previous 2 registries. The number of PCI performed at the same time as the diagnostic procedure—45 062 (79%) in 2006—increased by 17% with respect to 2005.

In 18.6% of the procedures, the patients were women and in 19.6%, they were over 75 years of age. In 5.3% of the cases, the PCI procedures were done on 1 or more restenotic lesions. Table 1 shows how the percentage PCI on restenotic lesions has progressively decreased, an observation which may partly be explained by use of drug-eluting stents. Saphena grafts accounted for 2.6% of all procedures (n=1472) and 186 PCI used mammary artery grafts. The number of procedures involving the

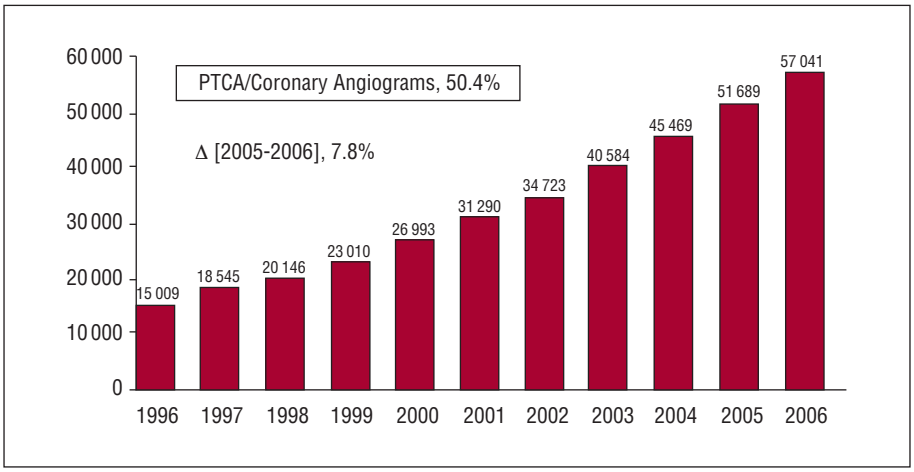


Figure 5. Change in the number of percutaneous coronary interventions between 1996 and 2006.

TABLE 1. **Change in Percentage of PCI in de Novo Lesions and in Restenotic Lesions (1998-2006)**[a]

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
PCI in de novo lesions	21 436	25 131	31 464	28 855	32 334	38 175	42 586	48 869	54 193
PCI for restenosis	2094	2344	2893	2435	2309	2409	2883	2820	2848
PCI for restenosis, %	9.8	9.3	9.2	8.4	7.1	6.3	6.8	5.8	5.3

[a]PCI indicates percutaneous coronary intervention.

left main coronary artery continued to increase in Spanish centers; in total, 1962 procedures were performed in 2006, and the artery was unprotected in 75% of these (n=1472), corresponding to 2.5% of all PCI procedures.

Glycoprotein IIb/III inhibitors were used as coadjuvant pharmacological treatment in 13 451 procedures (24.1%), abciximab being the most frequently used of this class (70.2%). Of note is the increase in use of eptifibatide from 1.8% in 2005 to 5.4% in 2006. This increase refers to the total number of procedures in which glycoprotein IIb/IIIa inhibitors were used. The timing of drug administration is not specified as this variable was not included in the data collection form for the registry. Counterpulsation intraaortic balloons were used 1040 times (a 24% increase compared to 2005), and use of other cardiac support methods was merely anecdotal, with only 14 cases being reported.

The distribution by autonomous region of the 1293 PCI/million inhabitants is shown in Figure 6. This distribution is less even than the diagnostic procedures. The range is greater than in 2005 (600 compared to 567 procedures), although the number of regions above the national average was greater in 2006 than 2005 (8 and 6, respectively). Examination of the distribution by centers (Figure 7) shows that the number of centers performing fewer than 500 PCI per year remains stable whereas the number of those that perform more than 1500 procedures a year increased notably from 1 to 3.

The percentage of successful outcomes from PCI procedures remained similar to previous years. Overall, 94% were successful, 4.6% were failures without complications, and 1.4% were failures with complications. The complications were as follows: 0.5% mortality, 0.8% acute myocardial infarction (AMI), and 0.1% emergency surgery.

Intracoronary diagnostic techniques (IVUS and pressure wires), probably used for deciding whether or not to treat lesions whose severity was difficult to determine, for improving the outcome of the procedure, or during investigation protocols, increased in 2006, and the ratios of use of IVUS and pressure wire per PCI procedure were 6.5% and 2.2%, respectively.

The radial artery was the access route in 29.3% of the PCI procedures compared to 26.9% in 2005. Femoral

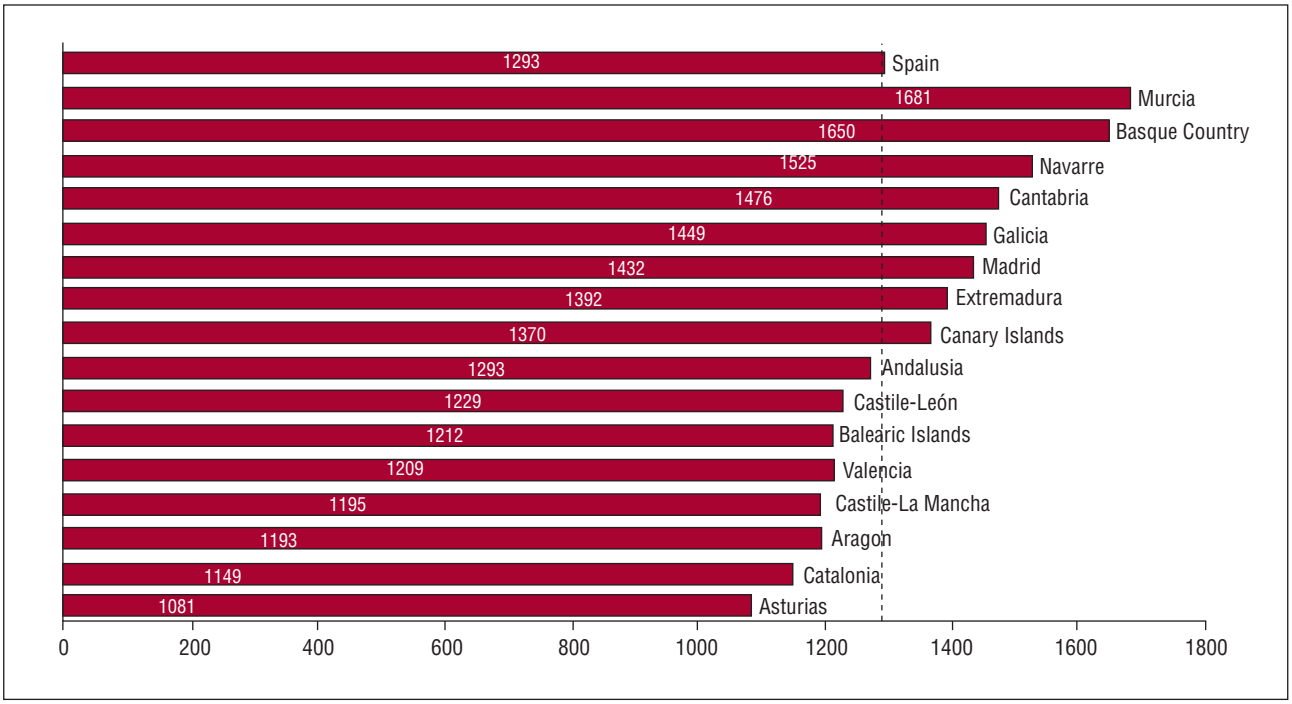


Figure 6. Distribution of percutaneous coronary interventions per million inhabitants by autonomous region.

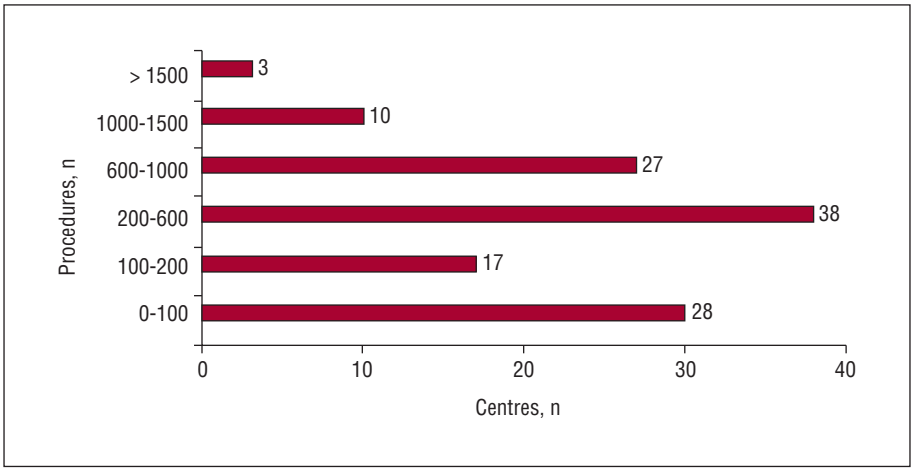


Figure 7. Distribution of centers according to the number of percutaneous coronary interventions done in 2006.

access was used to place 40 229 percutaneous closure devices, of which 59.5% were with collagen, 19.7% were with suture, and 20.8% were other types of device.

Stents

In 96.1% of the PCI procedures performed (n=54 816), some type of stent was implanted, and the ratio of stents/procedure (1.59) was similar to the figure for 2005 (1.61). The total number of stents implanted was 91 006, of which 59.3% were drug-eluting stents, representing an increase of 15.6% compared to the previous year, although this increase is clearly less than in previous years (40.5% for 2004-2005 and 80.7% for 2003-2004).

The use of drug-eluting stents showed large differences among autonomous regions, and varied between 78% and 40%, as shown in Figure 8.

In view of the controversy surrounding the safety of drug-eluting stents, a section has been included in the current registry for stent thrombosis. In total, 73 centers filled in this section, and 354 cases of stent thrombosis were reported (0.54% of the total number of conventional stents and 0.63% of the total number of drug-eluting stents). Of these, 60% were early events (within the first month after placement) and 58% took place in the drug-eluting stent. A further 26.5% were late thrombotic events, and most of these occurred in drug-eluting stents (72%). Finally, 13.6% of the thromboses were reported as very late (more than 1 year after placement); 70.8% of these were in drug-eluting stents. These figures for very late thromboses are approximate, as they were calculated using the number of stents implanted in 2006 when, by definition, some of the thromboses correspond to stenting done in 2005 or earlier.

Other Devices Used in Percutaneous Coronary Intervention

Rotational abrasion (rotablator) atherectomy procedures increased both in terms of the number of centers and in the total number of procedures: 52 centers (30% increase) and 642 PCI procedures (39% increase). Directional atherectomies were largely anecdotal, with just 4 cases, and no intracoronary brachytherapy was reported. Compared to the previous year, 20% fewer cutting balloons were used (1170 cases). Distal embolization protection devices were used in 235 procedures, that is, 10% fewer than in 2005.

The most substantial growth occurred in the use of thrombus extraction devices, whose usage increased 33% compared to last year and continued the trend towards increased use of previous years (43% in 2005 and 42% in 2004).

Interventions During AMI

A total of 100 centers provided data on interventions during AMI. There were 10 067 procedures reported during AMI, that is, 17.6% of the total number of PCI procedures and an increase of 20.6% compared to 2005, clearly greater than the increase of 13.8% in the preceding year. Our current data are comparable with those of the European Registry for 2005, with a similar percentage of PCI procedures done during infarction compared to the total (17.9%, personal communication from Dr Bernhard Meier). Of the total number of procedures, 2012 (20%) were performed in women. In patients over 75 years of age, 2109 procedures (21%) were performed.

Within the variety of PCI procedures done during the acute phase of AMI, the distribution is similar to previous years: 62.7% of primary PCI (61.2% in 2005 and 63% in 2004), 19.2% rescue PCI (21.2% in 2005 and 20.8% in 2004), and 18.1% of facilitated PCI (17.6% in 2005 and 15.9% in 2004) (Figure 9). The growing number of interventional procedures in AMI is due to increased primary and facilitated PCI (24% in both cases), with a small increase in rescue PCI (9%). For an annual estimate of 40 000 admissions to Spanish hospitals for AMI,[16,17] primary PCI would be applied in only 15.7% of the cases of AMI.

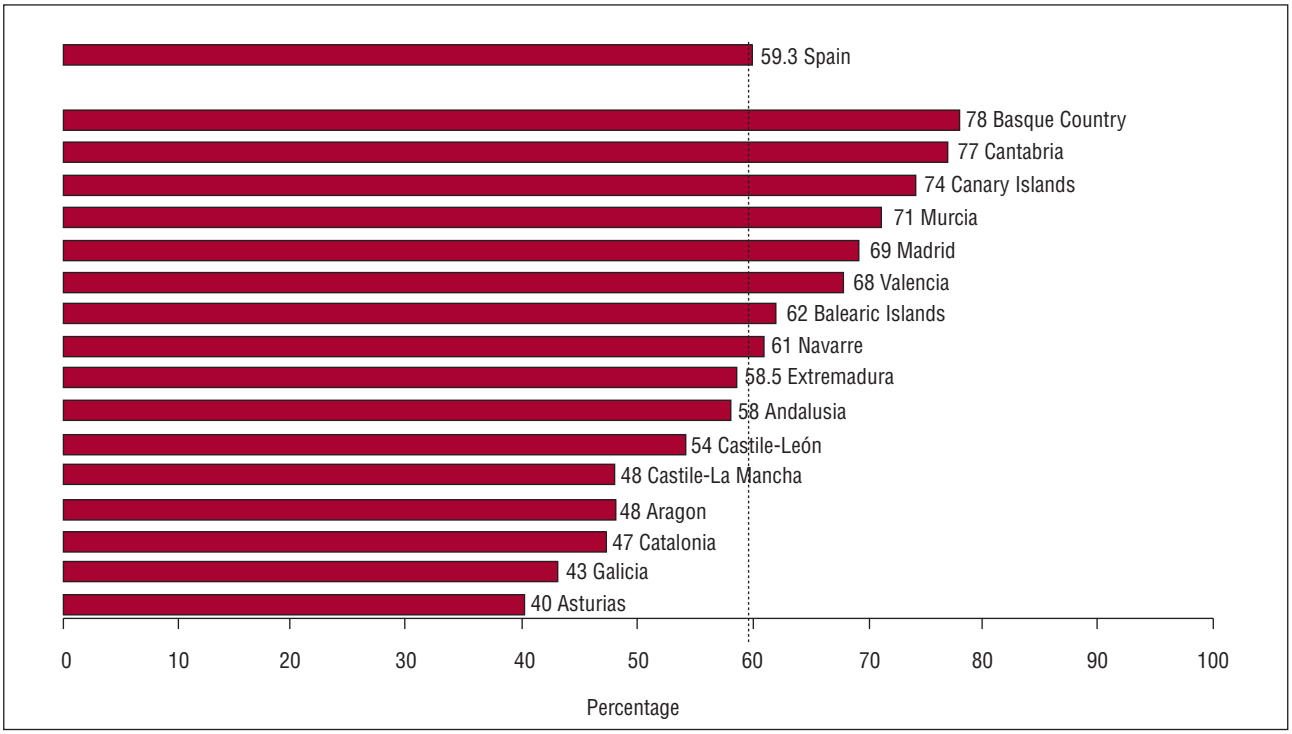


Figure 8. Distribution of the percentage of drug-eluting stents compared to the total number of stents implanted according to autonomous region.

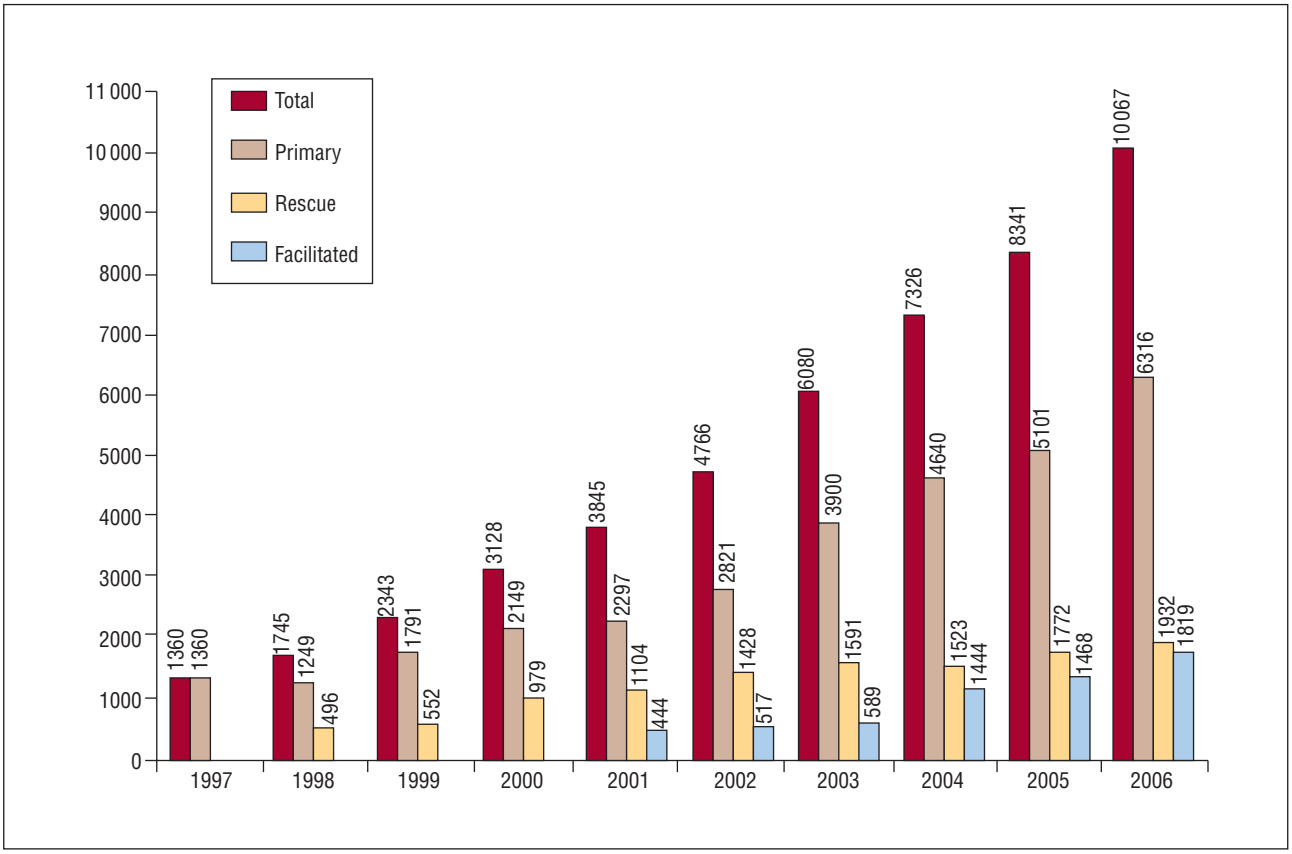


Figure 9. Distribution of percutaneous coronary interventions during acute myocardial infarction.

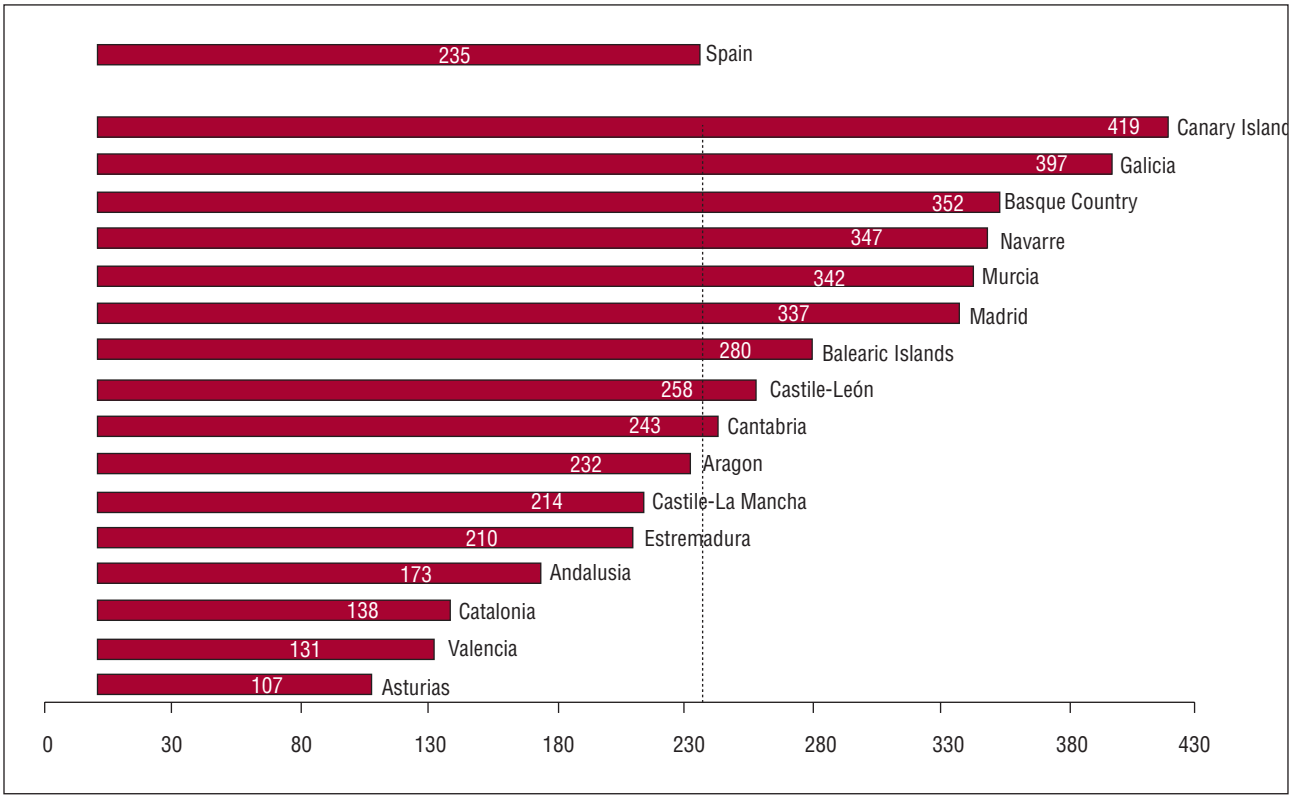


Figure 10. Distribution of percutaneous coronary interventions during acute myocardial infarction per million inhabitants by autonomous region.

The national distribution of PCI in AMI showed large variations, with a mean of 235 PCI procedures/million inhabitants and a range of 312 procedures (Figure 10).

The mean number of PCI procedures per center exceeds that of last year, and in 2006, 100 procedures were reported per center, although the variability of 2005 was retained, with 63 centers performing fewer than 100 PCI procedures/year during AMI (Figure 11).

As in other procedures, radial access was also used in PCI during AMI, in a total of 2606 procedures, corresponding to 25.8% of the total. This percentage represents an increase compared to the previous year.

There were 618 PCI procedures in patients who were in cardiogenic shock in the acute phase of AMI. In-hospital mortality in this group was 39%.

Noncoronary Interventions in Adults

The decrease in valvuloplasties seen in previous years no longer occurred. A total of 431 such procedures were performed during 2006. In total, 390 procedures (90.4%) were done on the mitral valve, 14 on the aortic valve, and 27 on the pulmonary valve (Figure 12). Mitral valvuloplasty was successful in 93.6% procedures, and major complications were reported in 3.8% of the procedures. The most common complication was severe mitral valve regurgitation after valvuloplasty (3.1%), followed by tamponade (0.5%), and death (0.2%).

Treatment of congenital heart disease in adults is the most common noncoronary interventional procedure in the current registry. A total of 601 procedures were performed, and the most frequent was closure of atrial septal defect (ASD), with 334 cases in total, of which 93.7% were performed with success. There were complications in 2.7% of the procedures although no patients died. A total of 192 patent foramen ovales were closed, with success in 98% of the procedures. Aortic coarctations were treated in 34 patients. The remaining 41 procedures included closure of ductus, ventricular septal defect, and fistula closure.

Twenty-eight septal ablations were performed in obstructive hypertrophic cardiomyopathy. A total of 45 paravalvular leaks were treated, of which 33 were located near the mitral valve and 12 near the aortic valve.

Forty-five procedures were done with implantation of aortic endoprosthesis, 14 of which were placed in the abdominal aorta, and 31 in the thoracic aorta.

Finally, we should highlight that there was an increase of 41.5% in percutaneous implantation of stem cells, corresponding to 75 cases.

Interventional Procedures in Pediatric Patients

A total of 23 centers provided data on catheterization procedures in pediatric patients, reporting 992 procedures in 2006. The most frequently performed procedures were

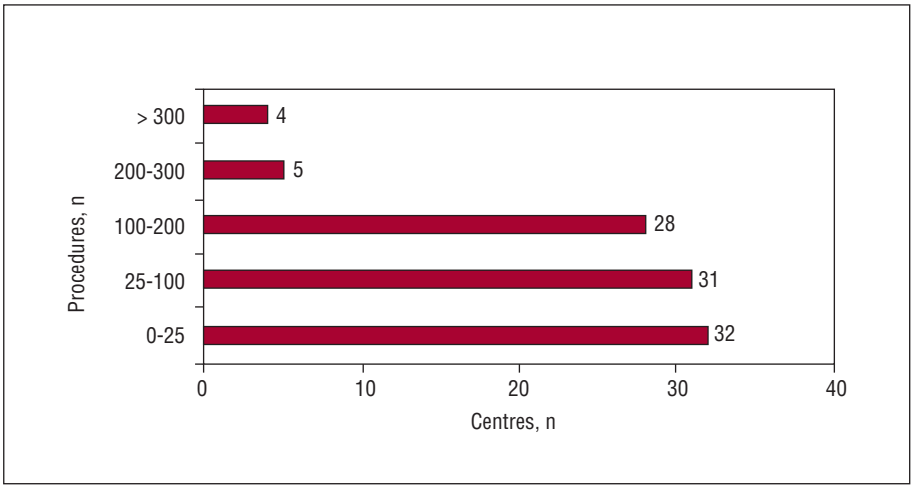


Figure 11. Distribution of centers according to the number of percutaneous coronary interventions during acute myocardial infarction.

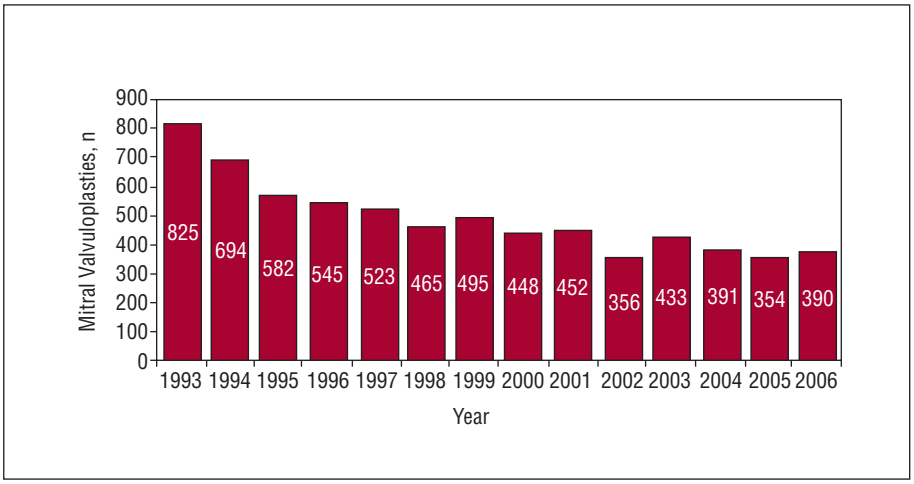


Figure 12. Change in number of mitral valvuloplasties in Spain.

vascular or valve dilatations (n=269). Closure of ASD and persistent ductus arteriosus accounted for 35.7% of the total, with 187 and 166 cases, respectively. Pediatric procedures presented in detail in Figure 13.

CONCLUSIONS

In 2006, the activity of the Spanish hospitals that undertake PCI procedures followed the upward trends in the number of procedures that had been seen in previous years.

Diagnostic procedures increased due to increases in the number of coronary angiograms and the national distribution showed less variability than in previous years among different autonomous communities, probably due to better distribution of resources, with new laboratories being opened in a greater number of provinces. The total number of diagnostic procedures in patients with congenital heart disease and valve disease showed no increase. Intracoronary diagnostic techniques increased mainly due to an increase in intracoronary ultrasound.

The differences in general coronary procedures among different regions of Spain were in general maintained.

It is likely that the clinical practice guidelines for management of AMI have led to an increase in the number of interventional procedures through an increase in the number of primary PCI procedures. Nevertheless, there are marked differences between autonomous regions in favor of those with a specific patient protocol for ST-elevation AMI.

Drug-eluting stents were implanted in more than half the patients who received stents, and the national average is 59.3%, although the variability between autonomous regions is high, with a similar distribution to previous years. The use of rotational atherectomy has increased considerably both in terms of the number of centers and the number of procedures, probably as a result of the greater complexity of the lesions currently treated.

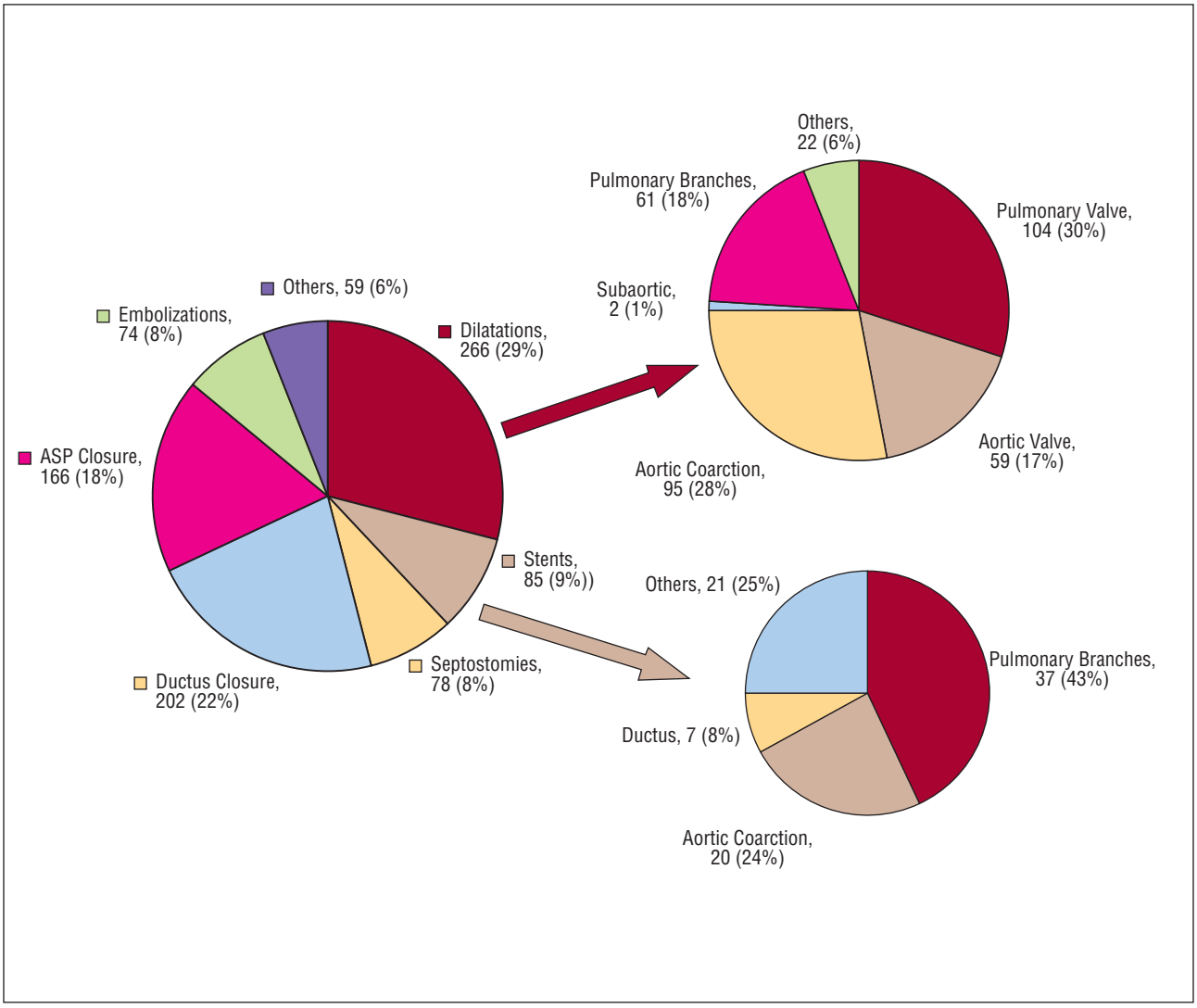


Figure 13. Distribution of pediatric procedures.

The radial approach continues to gain in popularity and the proportion of cardiologists using this approach increased. In the case of diagnostic procedures, this approach accounted for 38% of procedures. Also of note is the use of this approach in patients with AMI (25% of PCI procedures).

Within Europe, Spain is below average in terms of the number of coronary procedures per million inhabitants, whether interventional or diagnostic, but the year-on-year increases are larger for both types of procedure.

With regard to interventional procedures, both valvuloplasties and treatment of congenital heart disease in adults, the number of procedures has leveled off compared to the last 2 years, thus ending the gradual decline in the number of such procedures performed.

Procedures in pediatric patients were at similar levels to the 2005 registry.

ACKNOWLEDGMENTS

The Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology would like to thank the heads of the catheterization laboratories throughout Spain and those responsible for data collection for their efforts to make this registry possible.

REFERENCES

1. Mainar V, Gómez-Recio M, Martínez Elbal L, Pan M. Registro Nacional de actividad de la Sección de Hemodinámica y Cardiología Intervencionista de los años 1990 y 1991. Rev Esp Cardiol. 1992;45:622-6.
2. Pan M, Martínez Elbal L, Gómez-Recio M, Mainar V. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1992. Rev Esp Cardiol. 1993;46:711-7.

3. Martínez Elbal L, Gómez-Recio M, Pan M, Mainar V. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1993. Rev Esp Cardiol. 1994;47:783-90.
4. Elízaga J, García E, Zueco J, Serra A. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1994. Rev Esp Cardiol. 1995;48:783-91.
5. Zueco J, Elízaga J, Serra A, García E. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1995. Rev Esp Cardiol. 1996;49:714-22.
6. Serra A, Zueco J, Elízaga J, García E. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1996. Rev Esp Cardiol. 1997;50:833-42.
7. Soriano J, Alfonso F, Cequier A, Morís C. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1997. Rev Esp Cardiol. 1998;50:927-38.
8. Soriano J, Alfonso F, Cequier A, Morís C. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1998. Rev Esp Cardiol. 1999;52:1105-20.
9. Soriano J, Alfonso F, Cequier A, Morís C. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista del año 1999. Rev Esp Cardiol. 2000;53;1626-38.
10. Hernández JM, Goicolea J, Durán JM, Auge JM. Registro de actividad de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología del año 2000. Rev Esp Cardiol. 2001;54:1426-38.
11. Hernández JM, Goicolea J, Durán JM, Auge JM. Registro Español de Hemodinámica y Cardiología Intervencionista. XI Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (años 1990-2001). Rev Esp Cardiol. 2002;55:1173-84.
12. Hernández JM, Goicolea J, Durán JM, Auge JM. Registro Español de Hemodinámica y Cardiología Intervencionista. XII Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (años 1990-2002). Rev Esp Cardiol. 2003;56:1105-18.
13. López-Palop R, Moreu J, Fernández-Vázquez F, Hernández R. Registro Español de Hemodinámica y Cardiología Intervencionista. XIII Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (años 1990-2003). Rev Esp Cardiol. 2004;57:1076-89.
14. López-Palop R, Moreu J, Fernández-Vázquez F, Hernández R. Registro Español de Hemodinámica y Cardiología Intervencionista. XIV Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (años 1990-2004). Rev Esp Cardiol. 2005;58:1318-34.
15. López-Palop R, Moreu J, Fernández-Vázquez F, Hernández R. Registro Español de Hemodinámica y Cardiología Intervencionista. XV Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (años 1990-2005). Rev Esp Cardiol. 2006;59:1146-64.
16. Marrugat J, Elosua R, Marti H. Epidemiología de la cardiopatía isquémica en España: estimación del número de casos y tendencias desde 1997 a 2005. Rev Esp Cardiol. 2002;55:337-46.
17. Ivarez-León EE, Elosua R, Zamora A, Aldasoro E, Galcera J, Vanaclocha H, et al. Recursos hospitalarios y letalidad por infarto de miocardio. Estudio IBERICA. Rev Esp Cardiol. 2004;57:514-23.

APPENDIX I. **Working Group on Cardiac Catheterization and Interventional Cardiology. Form for Recording Procedures**

0. PERMISSION TO PUBLISH DATA
0.1. The publication in the webpage of the Working Group on Cardiac Catheterization of the data contained in the sections marked with an[a] is authorized (YES/No) (REQUIRED FIELD).
0.2. The publication in the webpage of the Working Group on Hemodynamics of ALL DATA contained in the registry is authorized[a] (YES/No) (REQUIRED FIELD).

1. CENTRE INFORMATION
1.1 [a]Hospital
1.2 Address
1.3 Zip code
1.4 Province
1.5 Telephone
1.6 Extension
1.7 Fax
1.8 E-mail
1.9 Contact physician
1.10 Head of laboratory
1.11 Name of interventional cardiologists who work in the laboratory
1.11.1 Name of cardiologist 1
1.11.1.1 Full time/part time
1.11.2 Name of cardiologist 2
1.11.2.1 Full time/part time
1.11.3 Name of cardiologist 3
1.11.3.1 Full time/part time
1.11.4 Name of cardiologist 4
1.11.4.1 Full time/part time
1.11.5 Name of cardiologist 5
1.11.5.1 Full time/part time
1.11.6 Name of cardiologist 6
1.11.6.1 Full time/part time
1.11.7 Name of cardiologist 7
1.11.7.1 Full time/part time
1.11.8 Name of cardiologist 8
1.11.8.1 Full time/part time

2. LABORATORY INFORMATION
2.1 [a]Number of laboratories
2.1.1 Conventional
2.1.2 Computerized
2.2 Number of staff physicians
2.3 Number of staff physicians who do PCI
2.4 Number of registered nurses
2.5 Number of x-ray technicians
2.6 24-h emergency service
2.7 [a]Cardiovascular surgery available at the center
2.8 [a]Procedures database available

3. DIAGNOSTIC PROCEDURES
3.1 [a]Total number of diagnostic procedures

APPENDIX I. **Working Group on Cardiac Catheterization and Interventional Cardiology. Form for Recording Procedures** (continued)

3.1.1 [a]Number of coronary angiograms
[b]3.1.1.1 Number of coronary angiograms in women
[c]3.1.1.2. Number of coronary angiograms in patients aged 75 years or more
3.1.2 Number of studies in patients with valve disease
3.1.3 Number of endomyocardial biopsies
3.1.4 Number of adults with congenital heart disease
3.1.5 Number of pediatric patients (<16 years old)
3.1.6 Others
3.2 Number of procedures with radial approach

[a]The combination of left and right cardiac catheterization is considered as a single procedure regardless of whether it is accompanied by a coronary angiogram. A complete study in a patient with valve disease who also has a coronary angiogram is considered a single study in a patient with valve disease. A one-off coronary angiogram in a patient with valve disease is to be counted as a coronary angiogram. A biopsy in a patient with a coronary angiogram is a single procedure and should be counted as a biopsy so as not to interfere with the ratio of coronary angiograms to PCI. The sum of values in Sections 3.1.1 to 3.1.6 should equal the figure in Section 3.1 (total number of procedures).
[b]If the information is not available, leave the box blank, do not give an estimate.

4. OTHER DIAGNOSTIC CORONARY STUDIES
4.1 Quantitative coronary angiogram
4.2 Number of intracoronary ultrasound studies
4.3 Number of studies with pressure wire
4.4 Number of studies with Doppler flow wire
4.5 Number of other studies with invasive coronary diagnostic procedure
4.5.1 Specify:

These coronary studies are not counted separately within the total number of diagnostic and interventional procedures. For example, a diagnostic coronary angiogram accompanied by a study with a pressure wire only counts as a coronary angiogram (3.1.1) and, logically, a single diagnostic procedure (3.1) would also count as a pressure wire study (4.3). A PCI with IVUS (intravascular ultrasound) is a single interventional procedure (5.1) and a study with intracoronary ultrasound (4.2).

5. INTERVENTIONAL CORONARY PROCEDURES
5.1 Total number of procedures[a]
5.2 Number of multivessel procedures
5.3 Number of procedures at the same time as diagnostic procedures
5.4 Number of procedures for restenosis[b]
5.5 Number of procedures with at least 1 saphenous vein graft
5.6 Number of procedures with at least 1 mammary artery graft
5.7 Number of procedures in the left main coronary artery
5.7.1 Protected
5.7.2 Unprotected
5.8 Number of procedures with balloon intervention only
5.9 Number of procedures with radial approach
5.10 Number of procedures with GP IIb/IIIa inhibitors
5.10.1 Abciximab
5.10.2 Eptifibatide
5.10.3 Tirofiban
5.11 Number of procedures with ionic contrast
5.12 Number of procedures with nonionic contrast
5.13 Number of vessels treated[c]
5.14 Number of lesions treated
5.15 Outcomes of interventional coronary procedures
5.15.1 Total number of successful procedures
5.15.2 Total number of failed procedures without complications
5.15.3 Total number of procedures with major complications
5.15.3.1 Nonfatal AMI
5.15.3.2 Emergency surgery (24 h)
5.15.3.3 Death secondary to the procedure performed
5.15.4 In-hospital death
5.15.5 Stent thrombosis[d]
5.15.5.1 Early thrombosis in conventional stent (0-30 days)
5.15.5.2 Early thrombosis in drug-eluting stent (0-30 days)
5.15.5.3 Late thrombosis in conventional stent (31-365 days)
5.15.5.4 Late thrombosis in drug-eluting stent (31-365 days)
5.15.5.5 Very late thrombosis in convention stent (>365 days)
5.15.5.6 Very late thrombosis in drug-eluting stent (>365 days)
[c]5.16 Number of coronary interventional procedures in women
[c]5.17. Number of coronary angiograms in patients aged 75 years or more

[a]A therapeutic coronary procedure is defined as an attempt to treat one or more coronary lesions, provided an attempt is made to introduce a guidewire into a coronary artery. Regardless of how many devices are used in the same procedure (stent, IVUS, atherectomy, etc), it will only count as a single procedure.
[b]At least 1 of the treated lesions in a session is restenotic.
[c]According to convention, the following vessels are considered: left main coronary artery, left anterior descending, circumflex artery, right coronary artery, and each arterial graft. (A patient with native arteries can only be treated in 4 vessels.)
[c]If the information is not available, leave the box blank.
[d]Stent thrombosis is considered as definitive thrombosis when there is angiographic or histopathological confirmation that it is present.

6. SUPPORT METHODS FOR INTERVENTIONAL PROCEDURES
6.1 Number of procedures with intraaortic balloon counterpulsation
6.2 Number of procedures with percutaneous extracorporeal circulation

7. PERCUTANEOUS CORONARY INTERVENTION FOR ACUTE MYOCARDIAL INFARCTION
7.1 [a]Total number of diagnostic procedures during AMI
7.1.1 Primary PCI[a]
7.1.2 Rescue PCI[b]
7.1.3 Facilitated PCI
7.1.3.1 Immediate facilitated PTCA[c]
7.1.3.2 Delayed facilitated PTCA[d]
7.1.4 Approximate percentage of primary PCI with respect to total AMI
7.1.5 Time from door to balloon procedure
7.2 Outcomes of PCI during AMI (overall, including cardiogenic shock)
7.2.1 Success without complications
7.2.2 Failure without major complications

APPENDIX I. **Working Group on Cardiac Catheterization and Interventional Cardiology. Form for Recording Procedures** (continued)

7.2.3 Procedures with major complications
7.2.4 In-hospital death
7.3 Number of stent procedures
7.4 Number of procedures with balloon intervention only
7.5 Number of procedures with GP IIb/IIIa inhibitors
7.6 Number of procedures with thrombus aspiration devices
7.7 Number of procedures with distal embolization protection
7.8 Number of patients in cardiogenic shock within 24 hours of onset of AMI
7.9 Outcomes of PCI in patients in cardiogenic shock
7.9.1 Success without complications
7.9.2 Failure without complications
7.9.3 Procedures with major complications
7.9.4 In-hospital death
7.10 Number of procedures done with radial approach
[e]7.11 Number of procedures for AMI in women
[e]7.12 Number of procedures for AMI in patients aged 75 years or more

[a]PTCA performed during acute phase of AMI (first 12 h) without any prior thrombolytic therapy.
[b]PTCA performed during acute phase of AMI after thrombolytic therapy due to clinical suspicion of reperfusion failure with thrombosis.
[c]PCI performed electively in the first 3 hours after administration of thrombolytic therapy and a platelet IIb/IIIa antagonist.
[d]PCI performed electively between 3 and 24 hours after successful administration of thrombolytic therapy and a platelet IIb/IIIa antagonist.
[e]If the information is not available, leave the box blank.

8. CORONARY STENTING
8.1 Total number of procedures[a]
8.2 Total number of stents implanted
8.3 Number of stents implanted without predilatation
8.4 Total number of procedures without predilatation[b]
8.5 Total number of drug-eluting stents (active coating)

[a]The procedure is defined in the same way as the interventional procedure (5.1)
[b]All lesions treated without predilatation during 1 session.

9. OTHER DEVICES/PROCEDURES
9.1 Directional atherectomy
9.2 Rotational atherectomy
9.3 Other types of atherectomy
9.4 Coronary laser
9.5 Laser guidewire
9.6 Thrombus aspiration techniques
9.7 Distal embolization protection devices
9.8 Radiofrequency balloon
9.9 Ultrasound therapy
9.10 Cutting balloon
9.11 Other special balloons (with protrusions, guidewire)
9.12 Embolization of fistulas

[a]These include procedures during AMI and when AMI is not present.

10. OTHER NONCORONARY PROCEDURES/DEVICES
10.1 Transmyocardial laser
10.2 Septal branch ablation
10.3 Percutaneous transplantation of stem cells
10.4 Stenting of the aortic artery
10.4.1 Abdominal
10.4.2 Thoracic
10.5 Renal artery dilatation
10.6 Paravalvular leak closure
10.6.1 Mitral
10.6.2 Aortic

11. PERCUTANEOUS VASCULAR CLOSURE DEVICES
11.1 Number of percutaneous closure devices
11.1.1 With collagen
11.1.2 With suture
11.1.3 Other

12. INTERVENTIONS IN ADULT PATIENTS WITH VALVE DISEASE

13.1 Total number of mitral valvuloplasty procedures
Outcomes
13.1.1 Success
13.1.2 Failure without complications
13.1.3 Complications
13.1.3.1 Cardiac tamponade
13.1.3.2 Severe mitral regurgitation
13.1.3.3 Stroke
13.1.3.4 Death
13.2 Total number of aortic valvuloplasty procedures
Outcomes
13.2.1 Success
13.2.2 Failure without complications
13.2.3 Complications
13.2.3.1 Severe aortic regurgitation
13.2.3.2 Stroke
13.2.3.3 Death
13.3 Total number of pulmonary valvuloplasty procedures
Outcomes
13.3.1 Success
13.3.2 Failure without complications
13.3.3 Complications
13.3.3.1 Cardiac tamponade
13.3.3.2 Death

14. PROCEDURES IN ADULTS WITH CONGENITAL HEART DISEASE
14.1 Number of procedures to close atrial septal defect
14.1.1 Success
14.1.2 Failure without complications
14.1.3 Major complications
14.1.3.1 Death
14.1.3.2 Stroke
14.1.3.3 Tamponade
14.3.3.4 Device embolization
14.2 Number of procedures for aortic coarctation
14.3 Number of procedures to close patent foramen ovale
14.1.1 Success
14.1.2 Failure without complications

APPENDIX I. **Working Group on Cardiac Catheterization and Interventional Cardiology. Form for Recording Procedures** (continued)

14.1.3 Major complications
14.1.3.1 Death
14.1.3.2 Stroke
14.1.3.3 Tamponade
14.3.3.4 Device embolization
14.4 Other procedures in adults with congenital heart disease (specify):
14.5 Specification of other procedures:

15. THERAPEUTIC PROCEDURES IN PEDIATRIC PATIENTS (≤16 years)

15.1 Dilatations
15.1.1 Pulmonary valve
15.1.2 Aortic valve
15.1.3 Aortic coarctation
15.1.4 Subaortic stenosis
15.1.5 Pulmonary arteries
15.1.6 Other dilatations
15.2 Stenting
15.2.1 Pulmonary arteries
15.2.2 Aortic coarctation
15.2.3 Ductus
15.2.4 Other sites
15.3 Atrial septostomy
15.3.1 In the ICU
15.3.2 In the catheterization laboratory
15.4 Ductal closure
15.5 Atrial septal defect closure
15.6 Embolizations
15.7 Other

16. OBSERVATIONS AND REMARKS
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APPENDIX 2. **Registry of Activity of the Working Group on Cardiac Catheterization and Interventional Cardiology. Laboratories Participating in the 2006 Registry**

Andalusia
- Almería
  - Complejo Hospitalario Torrecárdenas
  - Hospital Virgen del Mar
- Cadiz
  - Hospital Universitario Puerta del Mar
  - Hospital Universitario Puerto Real
  - Hospital de Jerez de la Frontera
  - Clínica Ntra. Sra. de la Salud
- Cordoba
  - Hospital Universitario Reina Sofía
- Granada
  - Hospital Universitario Virgen de las Nieves
- Huelva
  - Hospital Juan Ramón Jiménez
- Jaén
  - Complejo Hospitalario Universitario de Jaén
- Malaga
  - Complejo Universitario Carlos Haya
  - Hospital Clínico Universitario Virgen de la Victoria
  - Hospital Costa del Sol
  - Clínica Xanit Internacional de Benalmádena
  - Clínica Parque San Antonio
  - USP Marbella
  - Clínica El Ángel
  - Clínica Santa Elena
- Seville
  - Hospital Universitario Virgen del Rocío
  - Hospital Universitario Virgen Macarena
  - Hospital Universitario de Valme

Aragon
- Saragossa
  - Hospital Clínico Universitario Lozano Blesa
  - Hospital Universitario Miguel Servet

Principality of Asturias
- Hospital Central de Asturias
- Centro Médico de Asturias

Balearic Islands
- Hospital Son Dureta
- Policlínica Miramar
- Clínica Rotger
- Clínica Palmaplanas
- Clínica Juaneda
- Policlínica Nuestra Señora del Rosario (Ibiza)

Canary Islands
- Las Palmas
  - Hospital de Gran Canaria Dr. Negrín
  - Hospital Universitario Insular de Gran Canaria
  - Clínica San Roque
- Santa Cruz de Tenerife
  - Hospital Universitario de Canarias
  - Complejo Hospitalario Ntra. Sra. de la Candelaria
  - Hospiten Rambla

APPENDIX 2. **Registry of Activity of the Working Group on Cardiac Catheterization and Interventional Cardiology. Laboratories Participating in the 2006 Registry** (continued)

Cantabria
- Hospital Universitario Marqués de Valdecilla

Castile-León
- Valladolid
  - Hospital Clínico Universitario de Valladolid
  - Hospital Campo Grande (CEMIN)
- Salamanca
  - Hospital Universitario de Salamanca
- León
  - Hospital de León
- Burgos
  - Hospital General Yagüe

Castile-La Mancha
- Toledo
  - Hospital Virgen de la Salud
- Albacete
  - Hospital General de Albacete
- Guadalajara
  - Hospital Universitario Guadalajara
- Ciudad Real
  - Hospital General de Ciudad Real

Catalonia
- Barcelona
  - Ciutat Sanitària i Universitària de Bellvitge
  - Hospital Clínic i Provincial de Barcelona
  - Hospital de la Santa Creu i de Sant Pau
  - Hospital General Universitari Vall d'Hebron
  - Hospital Universitari Germans Trias i Pujol
  - Hospital del Mar
  - Hospital General de Catalunya
  - Centre Cardio-Vascular Sant Jordi
  - Centro Médico Teknon
  - Clínica Quirón
  - Hospital de Barcelona-SCIAS
  - Clínica Corachàn
  - Clínica La Alianza-ANGIOCOR
  - Mútua de Terrassa
  - Centro Médico Delfos
- Girona
  - Hospital Universitari Dr. Josep Trueta
- Tarragona
  - Hospital Juan XXIII
- Lleida
  - Hospital Universitari Arnau de Vilanova

Community of Madrid
- Hospital Puerta de Hierro
- Hospital Universitario 12 de Octubre
- Hospital Clínico San Carlos
- Complejo Hospitalario Hospital Universitario de la Princesa
- Hospital General Universitario Gregorio Marañón
- Hospital Universitario La Paz
- Hospital Militar Gómez Ulla
- Hospital Ramón y Cajal
- Hospital de Alcorcón
- Cardioclinsa-Clínica Ntra. Sra. de América
- Clínica Moncloa Clínica Montepríncipe
- Clínica Ruber
- Hospital Ruber Internacional
- Fundación Jiménez Díaz
- Sanatorio La Milagrosa
- Centro Médico Zarzuela
- Clínica La Luz
- Sanatorio el Rosario
- Sanatorio La Paloma
- Clínica Alcorcón Sur
- Clínica La Moraleja

Autonomous Community of Valencia
- Alicante
  - Hospital General Universitario de Alicante
  - Hospital Universitario San Juan
  - Hospital General Universitario de Elche
  - Clínica Medimar
  - Sanatorio Perpetuo Socorro
  - Clínica Benidorm
  - Clínica San Jaime de Torrevieja
- Valencia
  - Hospital Clínico Universitario
  - Hospital General Universitario de Valencia
  - Hospital Universitario La Fe
  - Hospital Dr. Peset
  - Hospital de la Ribera
  - Hospital 9 Octubre
  - Clínica Virgen del Consuelo
  - Clinica Casa Salud
- Castellón
  - Hospital General de Castellón
  - Región de Murcia
  - Hospital Universitario Virgen de la Arrixaca
  - Hospital Santa María del Rosell
  - Clínica San Carlos
  - Clínica Virgen de la Vega

Extremadura
- Badajoz
  - Hospital Universitario Infanta Cristina
- Cáceres
  - Hospital de Cáceres
  - Clínica Virgen de Guadalupe

Galicia
- A Coruña
  - Complexo Hospitalario Juan Canalejo
  - Complexo Hospitalario Universitario de Santiago
  - Clínica USP Santa Teresa
  - Instituto Médico Quirúrgico San Rafael
  - Sanatorio Quirúrgico Modelo
- Pontevedra
  - Complexo Hospitalario Universitario de Vigo
- Orense
  - Centro Médico El Carmen

Autonomous Community of Navarre
- Hospital de Navarra
- Clínica Universitaria de Navarra

Basque Country
- Álava
  - Hospital Txagorritxu
- Guipúzcoa
  - Policlínica Guipúzcoa

APPENDIX 2. **Registry of Activity of the Working Group on Cardiac Catheterization and Interventional Cardiology. Laboratories Participating in the 2006 Registry** (continued)

Biscay
- Hospital de Basurto
- Hospital de Cruces
- Hospital de Galdakao
- Clínica V. San Sebastián

Hospitals With a Large Number of Procedures in Pediatric Patients

Barcelona
- Hospital Sant Joan de Déu
- Hospital Vall d'Hebron

Madrid
- Hospital 12 de Octubre
- Hospital La Paz
- Hospital Ramón y Cajal
- Hospital Gregorio Marañón

Seville
- Hospital Universitario Virgen del Rocío

Valencia
- Hospital Universitario La Fe

Saragossa
- Miguel Servet

Murcia
- Hospital Universitario Virgen de la Arrixaca