SPECIAL ARTICLE

Spanish Cardiac Catheterization and Coronary Intervention Registry. 15th Official Report of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology (1990–2005)

Ramón López-Palop, José Moreu, Felipe Fernández-Vázquez, and Rosana Hernández Antolín

Sección de Hemodinámica y Cardiología Intervencionista, Sociedad Española de Cardiología, Madrid, Spain.

This article summarizes the findings contained in the 2005 registry of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology. Data were obtained from 128 centers, which comprise almost all cardiac catheterization laboratories in Spain. Of these, 118 performed catheterizations mainly in adults, while 10 carried out procedures in only pediatric patients.

In 2005, 117 245 diagnostic catheterization procedures were performed, including 103 646 coronary angiograms, which was 5.9% more than in 2004. The population-adjusted rate was 2326 coronary angiograms per million inhabitants. A total of 51 689 coronary interventions were performed, which is 13.6% more than in 2004 and which corresponds to a rate of 1161 per million inhabitants. Coronary stents were used in 96% of procedures. Of the 80,569 stents implanted, 41 352 (51.3%) were drug-eluting stents. Some 8341 percutaneous coronary interventions were carried out in patients with acute myocardial infarction, which is 13.8% more than in 2004. They accounted for 16.1% of all such interventions.

Among the non-coronary interventions recorded, the number of percutaneous mitral valvuloplasties decreased by 7%. The number of procedures carried out to close atrial septal defects increased by 40% compared with 2004. The number of pediatric interventions increased by 1.7%. Finally, it is important to note that a large proportion of laboratories reported results, which helped to ensure that the data summarized here are highly representative of the work carried out at cardiac catheterization laboratories in Spain.

Key words: *Health registries. Coronary angiography. Coronary angioplasty. Stent. Cardiac catheterization.*

Registro Español de Hemodinámica y Cardiología Intervencionista. XV Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (1990-2005)

Se presentan los resultados del Registro de Actividad de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología del año 2005. Se recogen datos de 128 centros, casi la totalidad de los laboratorios del país. De ellos, 118 realizaron su actividad principalmente en pacientes adultos y 10 exclusivamente en pacientes pediátricos.

Se realizaron 117.245 estudios diagnósticos, con 103.646 coronariografías, lo que representa un aumento del 5,9% respecto al año 2004 y una tasa de 2.326 coronariografías por millón de habitantes. Se efectuaron 51.689 procedimientos de intervencionismo coronario, con un incremento del 13,6% respecto al año anterior y una tasa de 1.161 intervenciones por millón de habitantes. Se empleó *stent* intracoronario en el 96% de los procedimientos, con 80.569 unidades utilizadas, de las cuales, 41.352 fueron *stents* liberadores de fármacos antiproliferativos (51,3%). Se llevaron a cabo 8.341 procedimientos de intervencionismo en el infarto agudo de miocardio, lo que supone un 13,8% más respecto al año 2004 y el 16,1% del total de las intervenciones coronarias percutáneas.

En el intervencionismo no coronario se observó una disminución del número de valvuloplastias mitrales (7%) y un aumento de procedimientos de cierre percutáneo de comunicación interauricular en pacientes adultos (40%), así como un muy ligero incremento de los procedimientos intervencionistas en pacientes en edad pediátrica (1,7%). Finalmente, destaca el alto grado de participación de centros en el Registro, lo que hace que los datos aquí presentados sean representativos de la actividad hemodinámica en nuestro país.

Palabras clave: *Registros sanitarios. Angiografía coronaria. Angioplastia coronaria.* Stent. *Cateterismo cardiaco.*

Correspondence: Dr. R. López-Palop.
Vía Láctea, 38. Urb. La Glorieta. Churra. Murcia. España.
E-mail: mlopezs@meditex.es

Further information and other consultations available from http://www.hemodinamica.com

ABBREVIATIONS

AMI: acute myocardial infarction.
PCI: percutaneous coronary intervention.

INTRODUCTION

For the last 14 years, the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology has been publishing the results of its registry in the REVISTA ESPAÑOLA DE CARDIOLOGÍA. One of the most important tasks of this working group has been implementation of this registry, which has been collecting data continually since 1990. The registry of the Working Group on Cardiac Catheterization is the most up-to-date, complete, and rigorous record of interventional procedures performed in Spain. It collects data from both the public and private sectors and, at present, is the most complete registry of its kind in Europe.

The registry of the Working Group on Cardiac Catheterization and Interventional Cardiology aims to be the main source of information on diagnostic and interventional procedures performed by cardiac catheterization laboratories in Spain, changes over the years, and differences between Spanish autonomous regions. The data from the registry serve as a reference to guide decisions in all health care settings and so improve health care in aspects such as investigation, prevention, treatment, and assignment of resources.

This 15th report published in the REVISTA ESPAÑOLA DE CARDIOLOGÍA presents, as in previous years,[1-14] data from all public centers and almost all private centers. The data can therefore be considered as representative of catheterization procedures and percutaneous coronary interventions (PCI) in Spain.

METHODS

Data were collected for the registry by sending a questionnaire (Appendix 1) to all cardiac catheterization laboratories in Spain. This questionnaire underwent minor changes compared to previous ones and could be completed on a hardcopy printout, or electronically with a computer disk or via the Working Group's website. In recent years, the Governing Board of the Working Group has encouraged the use of the online form available from the group's website (www.hemodinamica.com). In this register for 2005, 76 centers (59% of respondents) used the Internet to report their data. As in previous years, the company Izasa collaborated both in the distribution and collection of the questionnaires, and the Governing Board of the Working Group was in charge of data analysis and responsible for the present publication.

The population data used for the different calculations of population-adjusted rates per million inhabitants, both at the national and regional level, were obtained from the estimates obtained from the Spanish National Institute of Statistics (January 1, 2005) through their webpage (http://www.ine.esine.es). Spain was estimated to have a population of 44 108 503 inhabitants in 2005.

Given the diversity of health care in Spain, public centers were taken to be those that, regardless of their source of funding, cater to a certain catchment area of the population within the public health care system.

Although it is relatively easy to compare the activity in Spain over the last 15 years, it is harder to compare the activity in Spain with that in the rest of Europe. Currently, there is no exhaustive and reliable European registry to match the Spanish one, and the partial data available are published with a delay of at least 3 years. Even so, comparisons between the situation in Spain and the rest of Europe are of interest, and in this article we discuss the most recently published data from the European registry (corresponding to 2002 and 2003).[15,16]

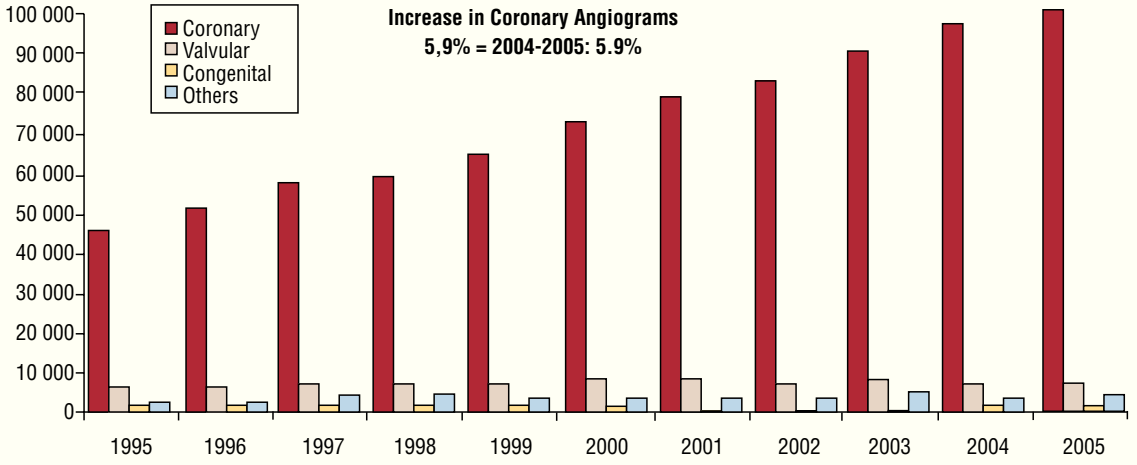
RESULTS

Infrastructure and Resources

One hundred and twenty-eight hospitals (Appendix 2) carrying out catheterization procedures in 2005 participated in the registry, comprising all public centers (72 hospitals) and 92% of the private ones (46 of 50) performing such activities. Of these 128 centers, 118 carried out procedures mainly in adult patients, 18 of these also admitted pediatric patients, and 10 centers treated pediatric patients only.

Hospitals for Adults

The 118 centers for adults have a total of 154 catheterization laboratories, of which 149 (97%) are fully computerized. The number of hospitals and laboratories works out at 2.7 and 3.5, respectively, per million inhabitants. Two or more catheterization laboratories are available in 36 centers. Overall, 41 centers are in the private sector (39.0%); the 77 remaining form part of the public health network (65.0%). Diagnostic and catheterization procedures are carried out in 99% of the hospitals. An emergency team is on standby 24 hours a day in 57% of the centers (59% of the public centers and 51% of the private ones). Heart surgery is available in 75% of the centers (n=89). In 29 of the centers that perform coronary interventions, heart surgery is not available in the same hospital. In the analysis of personnel, 367 physicians were working in 2005 (3.11/center; 8.3 specialists/10^6 inhabitants). This is similar to but slightly higher than in 2004 (when there were 8.01 specialists/10^6 inhabitants) and the most recent but nevertheless out-of-



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Coronary	45 623	51 661	57 960	59 321	65 234	73 382	79 607	83 667	90 939	97 785	103 646
Valvular	6872	6761	7681	8084	8426	9532	9452	8225	9168	8738	7978
Congenital	1710	1805	2191	2094	2248	1328	531	570	613	701	721
Other	3568	3734	4538	4865	6897	4097	5840	5027	5228	4227	4900
Total	57 773	63 961	72 370	74 364	82 805	88 339	95 430	97 609	105 939	111 451	117 245

Figure 1. Change in the number and type of diagnostic procedure done between 1995 and 2005.

date figure for Europe for 1995 of 8 specialists per million inhabitants.[17] The 104 hospitals reported 437 registered nurses and 109 x-ray technicians, corresponding to a mean number of nursing staff or x-ray technicians of 5.25 per center and 3.5 per laboratory (mean of 3.9 nurses or x-ray technicians per laboratory in the public sector).

Pediatric Hospitals

Ten of the centers included in the registry reported treating pediatric patients only, with 10 laboratories (all of which were computerized). All of these perform catheterization procedures and 50% also have an emergency team on standby 24 hours a day. These laboratories have 2.1 specialists and 2.4 nurses/x-ray technicians per center.

Diagnostic Procedures

In 2005, 117 245 diagnostic procedures were carried out in Spain, a 5.1% increase compared to 2004[14]; 103 646 of these procedures were coronary angiograms, representing a 5.9% increase. This rate of growth was similar to the average European growth between 2001 and 2002 (7%) and between 2002 and 2003 (5%).

Overall, 2326 coronary angiograms per million inhabitants were performed. This figure is still notably greater than the European average of 3357 coronary angiograms per million inhabitants and similar to European countries such as Greece, Portugal, or Hungary, although we should remember that the most recent data from the European registry to be published correspond to 2002.[18] The difference between Spain and other countries such as Germany (7791/10^6 inhabitants), Austria (5131/10^6 inhabitants), or France (3547/10^6 inhabitants) is still apparent.[18] Figure 1 presents the distribution of diagnostic procedures in 2005 and how this distribution has changed since 1993. The tendency in past years for the increase in the number of coronary angiograms to level off has continued, with a smaller increase of 5.9% compared to 6.6% between 2003 and 2004. A decrease in the number of diagnostic procedures was also observed compared to registry data from previous years.

The number of procedures with radial approach continues to increase. Indeed, this approach was used in 31 662 procedures (27.4%), which represents an increase of 56% with respect to the previous year. Percutaneous vascular closure devices (including diagnostic and therapeutic procedures) were used in 31 509 cases (an increase of 16% compared to 2004), of which 19 296 (62%) were with collagen, 8019 (25%) with suture, and 4194 with other systems (13%).

More than 1000 coronary angiograms per year were done in 48 centers (40.7%), and 11 of these hospitals (9.3% overall) carried out more than 2000 coronary angiograms per year. On the other hand, 44 centers (37.3%) performed fewer than 500 coronary angiograms per year (Figure 2). Only 6 of these hospitals were in the public sector (8%). There were 993 diagnostic procedures per center and 737 per laboratory, that is almost the same

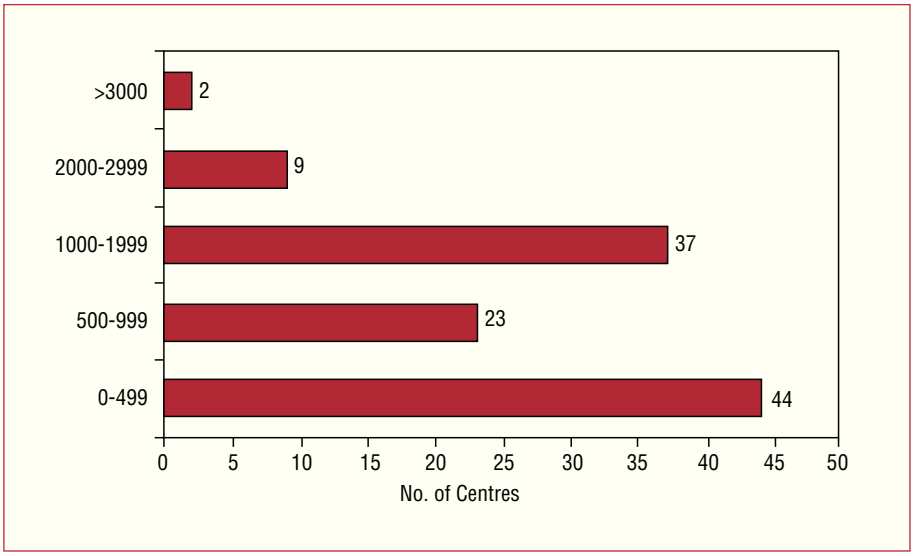


Figure 2. Distribution of centers according to the number of coronary angiograms performed.

number as in 2004. The average number of diagnostic procedures per laboratory is still below the European average for 2001 of 1019 procedures per laboratory.[18] In the public sector, 950 diagnostic procedures were performed per laboratory. The number of coronary angiograms per center (878) was 3% lower than in 2004[14] and is still below the already dated figure for 1997 in most western European countries.[19,20] It is also less than the 934 coronary angiograms per center recorded by the European registry for 1999.[20] It must be emphasized that, whereas centers in the private sector carried out 207 coronary angiograms per center, there were on average 1236 coronary angiograms per center in the public sector.

As in previous years, the growth in diagnostic studies reported in 2005 was due to the increased number of coronary angiograms. The number of procedures for congenital heart disease also increased notably (3%; 721 procedures), whereas the number of procedures in patients with valve disease decreased and the number of other diagnostic procedures increased.

In 2005, the notable differences between different autonomous regions of Spain in the number of coronary angiograms per million inhabitants remained. Figure 3 shows the data by Spanish autonomous region. The number of coronary angiograms per million inhabitants varied by 1444 per million inhabitants between the region with the highest number and the region with the lowest number (an increase in variation of 100 coronary angiograms compared to the range for 2004).

The 2 main intracoronary diagnostic techniques—intracoronary ultrasound imaging and procedures with intracoronary pressure guidewires—were used less compared to 2004. A total of 2871 intracoronary ultrasound imaging procedures were done (1% less than in 2004). Intracoronary pressure guidewires were used in 1138 procedures (16% less than in 2003). Intracoronary Doppler flow guidewires were used in almost half as many interventions as in the previous year (51 procedures). Intracoronary diagnosis accounted for 8% of interventional procedures (compared to 3.8% in the European registry for 2002[15]).

Percutaneous Coronary Intervention

During 2005, 51 689 PCI were done, an increase of 13.6% compared to the previous year, with 1161 PCI per million inhabitants (Figure 4). This figure is close to the latest data published from the European registry, corresponding to 2003[15] (1283 angioplasties/10^6 inhabitants). With reference to the European registry, the number of PCI per million inhabitants in Spain is comparable to the number in countries such as Denmark, Finland, or Italy in 2002, but a long way below other countries such as Germany, Belgium, Austria, or France, which easily exceeded 1500 PCI per million inhabitants in 2001. There were on average 438 PCI per hospital and 325 per laboratory. On average, each interventional cardiologist performed 153 interventions. The European average for PCI per catheterization laboratory was 325 in 2001.[18] There were on average 615 PCI per center in the public sector, corresponding to 422 per laboratory and 182 per cardiologist.

The percentage of PCI done as a result of coronary angiography findings in 2005 was 49.8% (44.3% in 2004), which was higher than the European average for 2003 (36%).[16] At least one restenotic lesion was treated during the intervention in 5.5% of the cases. In 2005, 13 955 multivessel procedures were performed, corresponding to 27% of all PCI. This percentage was very similar to the figure of 29% reported for 2004, but much greater than the figure of 17% reported for the European registry in 2003.[16] Likewise, no substantial differences were observed compared to 2004 for the percentage of procedures done in the same

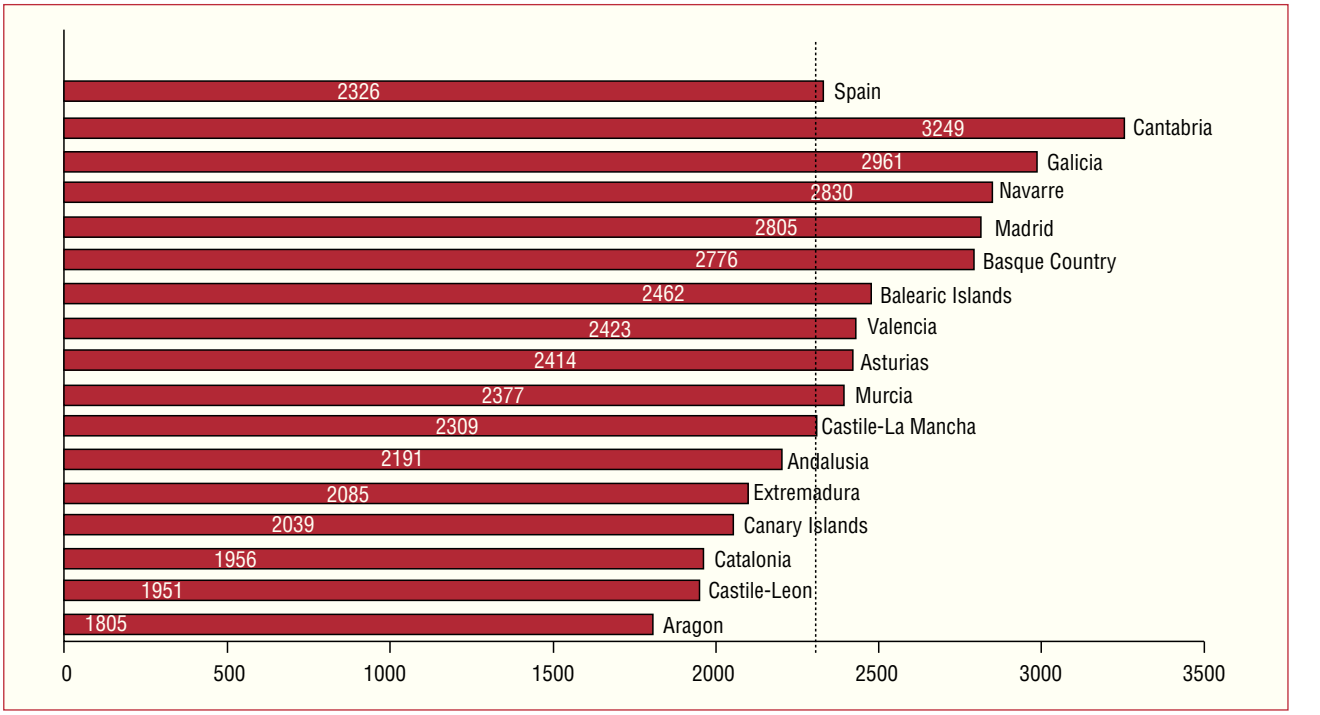


Figure 3. Distribution of coronary angiograms per million inhabitants by autonomous region.

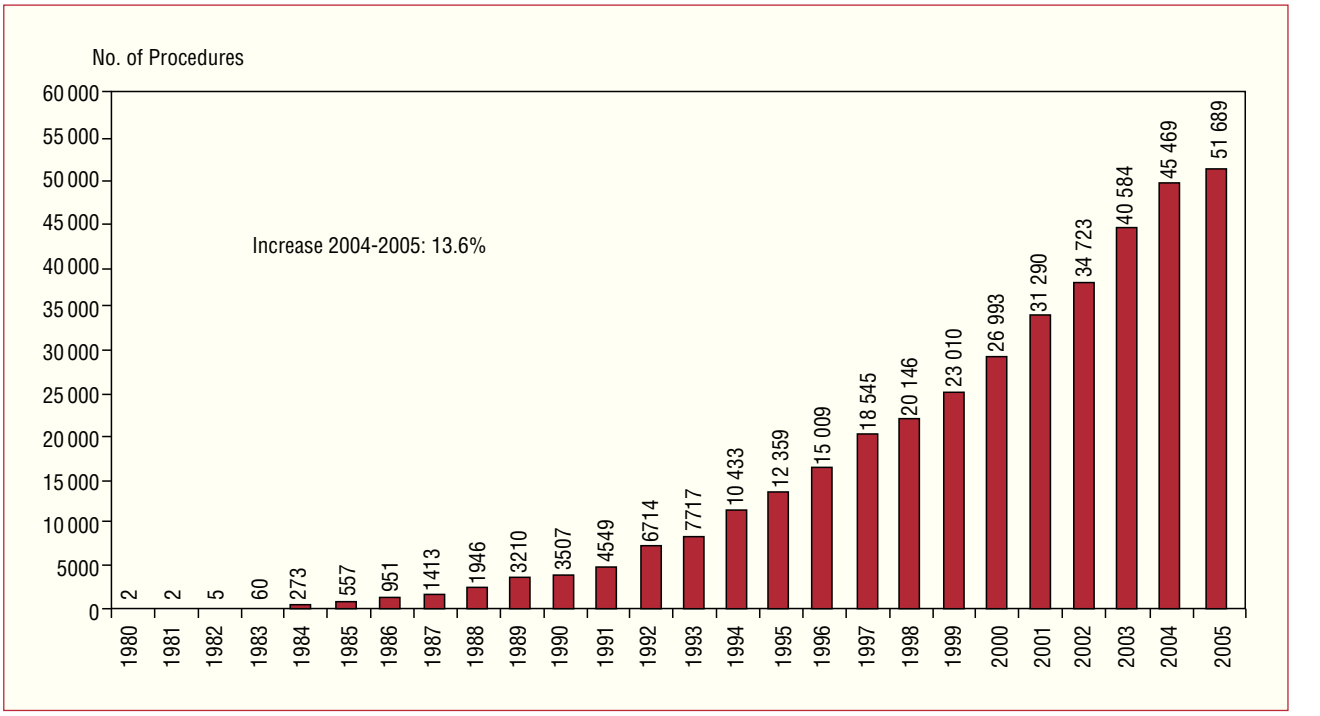


Figure 4. Change in the number of percutaneous coronary interventions between 1980 and 2005.

session as the diagnostic procedure (74%, 38 355 procedures).

The radial approach in PCI was used in 13 947 cases (26.9%), 88% more than in 2004. There were 1306 PCI involving grafting; 83.0% of which were saphenous vein grafts and the remainder (17.0%) corresponded to mammary artery grafts. Overall, 1464 PCI were carried out in the left main coronary artery, which was protected in 72% of cases.

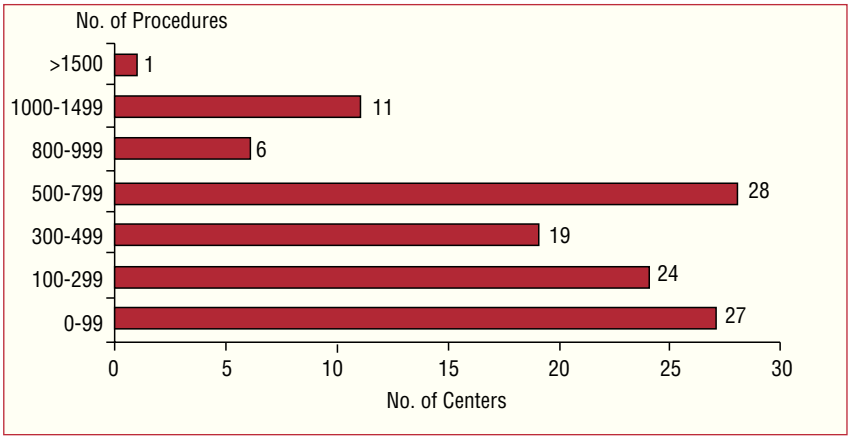


Figure 5. Distribution of centers according to the number of percutaneous coronary interventions done in 2005.

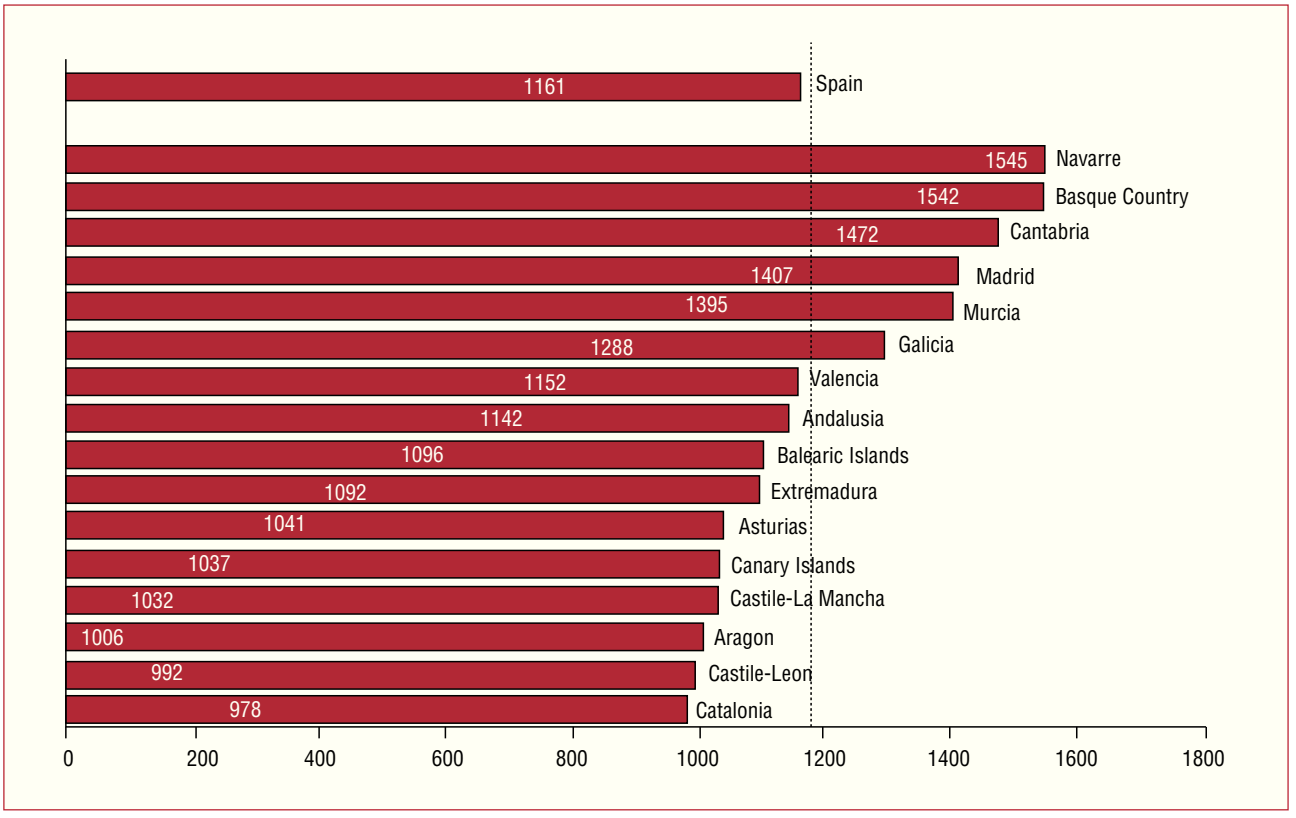


Figure 6. Distribution of percutaneous coronary interventions per million inhabitants by autonomous region.

Figure 5 shows the distribution of centers according to the number of PCI. As in previous years, a high number of centers were still carrying out fewer than 500 PCI per year (59%), or even fewer than 300 PCI per year (43%). Twelve centers carried out more than 1000 PCI in 2005. Figure 6 shows the number of PCI per million inhabitants in the different autonomous regions; the differences already indicated regarding diagnostic procedures were also observed for PCI. It is important to point out that, as in the case of coronary angiograms, in certain autonomous regions, the high percentage of PCI is due to the fact that patients from neighboring regions are treated in their centers.

Glycoprotein IIb/IIIa inhibitors were used as adjuvant drug therapy in 11 757 procedures, representing a decrease of 12.5% compared to 2005. It is impossible to tell what percentage of patients received glycoprotein IIb/IIIa inhibitors before the interventional procedure as this information is not collected in the registry, perhaps because it is not considered part of the activity of the laboratory or even because these agents were withdrawn hours before the intervention. This figure should therefore perhaps be

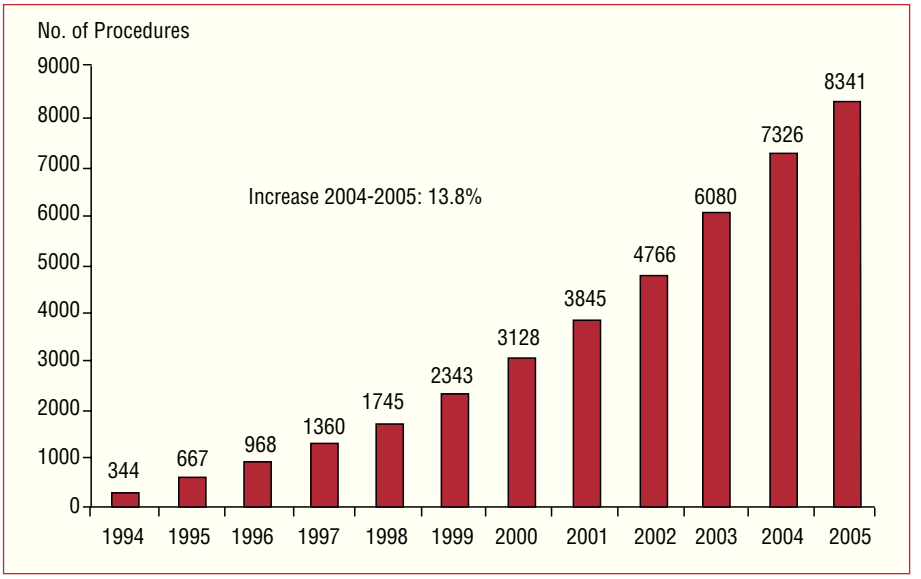


Figure 7. Percutaneous coronary interventions done for acute myocardial infarction. Changes between 1994-2004.

considered as the lower limit for use in Spain in 2005. Abciximab was used in 71% of interventions, tirofiban in 27%, and eptifibatide in 1.8%. Intraaortic balloon counterpulsation was used in 840 cases and percutaneous cardiopulmonary bypass in 13 cases.

For the overall outcomes of PCI, the figures remained similar to those of previous years; 95.5% were successful, 2.9% failed without complications, and 1.5% failed with complications. The breakdown of complications was as follows: 0.5% died, 0.9% suffered acute myocardial infarction (AMI), and 0.1% required emergency surgery.

Percutaneous Coronary Intervention in Acute Myocardial Infarction

A total of 8341 PCI procedures for AMI were carried out, representing an increase of 13.8% compared to 2004 and 16.1% of the total interventional procedures (Figure 7). In the European registry of 2003, the percentage of PCI procedures for AMI was 17% of all PCI.[16]

Overall, 61.2% of the cases involved primary PCI (63% in 2004), 21.2% rescue PCI (20.8% in 2004), and 17.6% facilitated PCI (15.9% in 2004) (Figure 8). Of the facilitated coronary angioplasties, 86% were considered "delayed" as they were carried out after the acute phase of the AMI. The 5101 primary angioplasty procedures represented an increase with respect to 2004 of 9.9%. This number of primary angioplasty procedures would correspond to approximately 12.5% of the estimated total number of 40 000 patients in Spain admitted each year to hospital with AMI.[21,22] Despite the recommendations made in the most recent clinical guidelines,[23] primary angioplasty is still not the treatment of choice for AMI in Spain. Overall, 103 centers carried out PCI for AMI. Although the average number of interventions per center was 81, the actual numbers varied widely (Figure 9); 30 centers performed more than 100 PCI in the acute phase

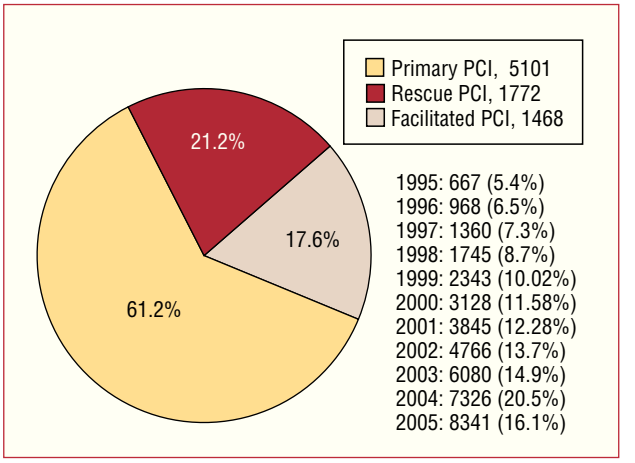


Figure 8. Percutaneous coronary interventions (PCI) done for acute myocardial infarction. Distribution of the type of intervention carried out and changes in percentages of total coronary interventions between 1995 and 2005.

of the infarction whereas 42% of the centers carried out fewer than 50.

Figure 10 shows the distribution of PCI for AMI per million inhabitants by autonomous region. Radial approach was used in 1747 procedures (representing 20.9% of the total number). Percutaneous coronary intervention was carried out during cardiogenic shock in 811 cases, representing 9.7% of all PCI for AMI.

Stents

Stents remain the principal device used in PCI. Stenting procedures were done 49 850 times, accounting for 96.4% of all procedures. The number of stents per procedure was 1.61 (1.51 in 2004) and the total number of units placed was 80 569. Drug-eluting stents were used in

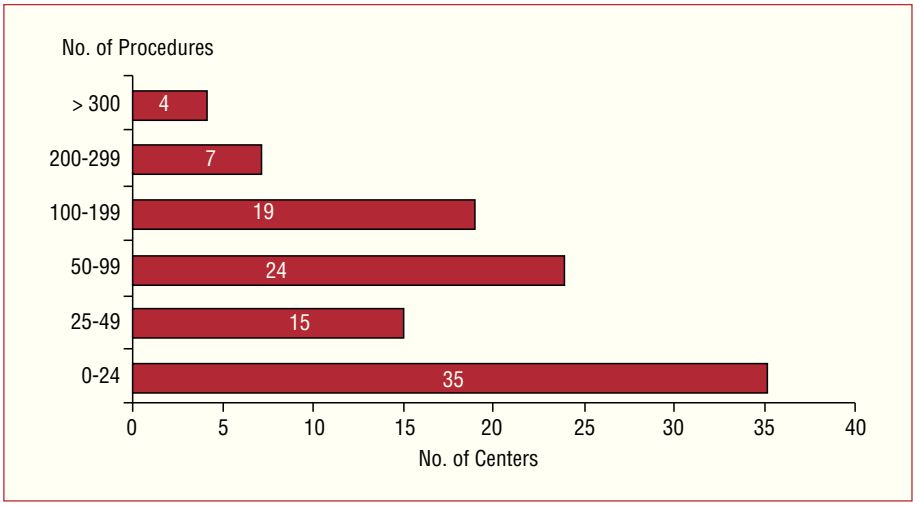


Figure 9. Distribution of centers according to the number of percutaneous coronary interventions for acute myocardial infarction.

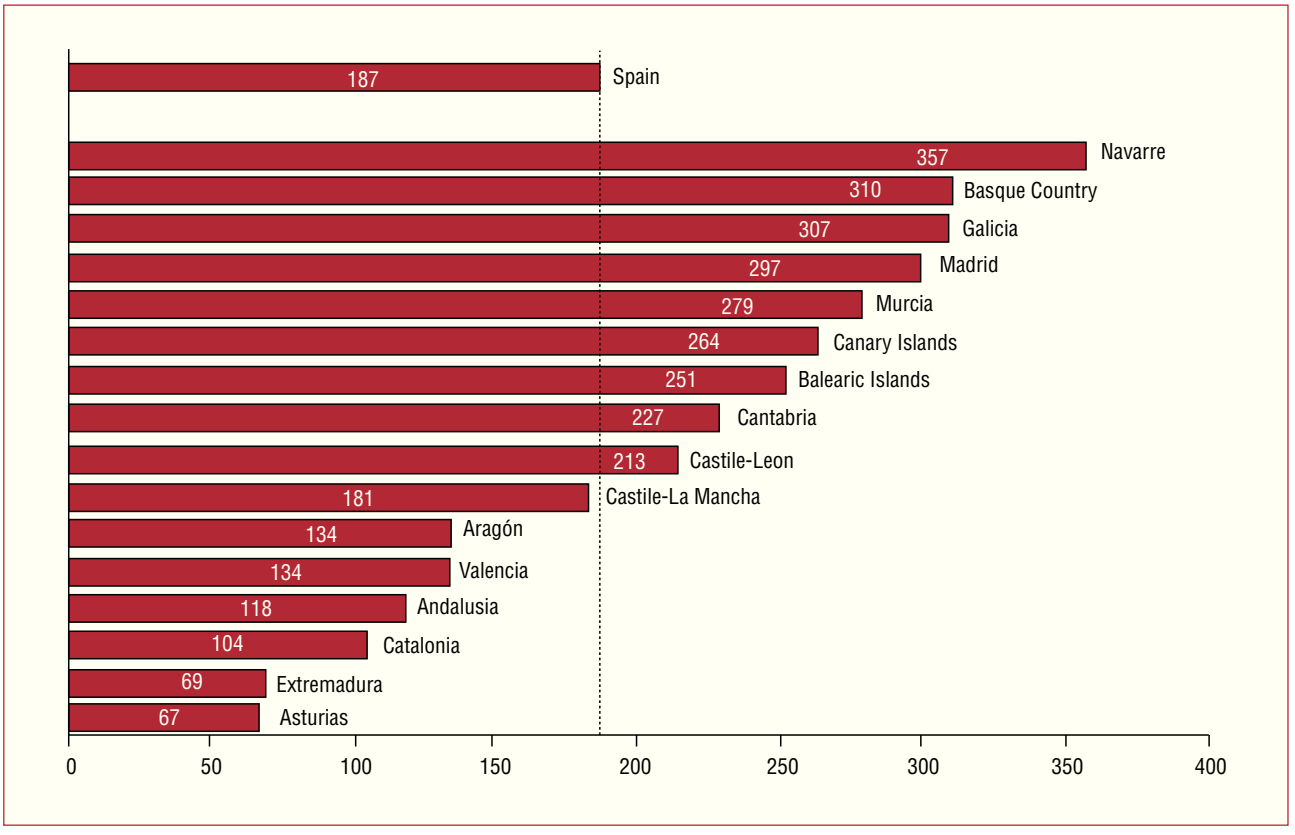


Figure 10. Distribution of percutaneous coronary interventions for acute myocardial infarction per million inhabitants by autonomous region.

41 352 patients, corresponding to 51.3% of all stents placed. Figure 11 reflects the large variations in extent of use of this type of stent, ranging between 72.8% and 35.7% according to autonomous region.

Finally, 28 670 stents were implanted directly, without balloon predilatation, representing 35.5% of stenting procedures. Twenty-eight percent of the stenting procedures were done without predilatation. The change in the number of stents implanted in recent years is shown in Table 1.

Other Percutaneous Coronary Intervention Devices

Use of directional atherectomy stopped completely in 2005. Rotational atherectomy was used in 460 procedures in 40 centers, representing an increase of 2% in use compared to 2004 (Table 2). Of the other PCI devices, the cutting balloon continues to become more widespread, being used in 1475 procedures, an increase of 9.7%.

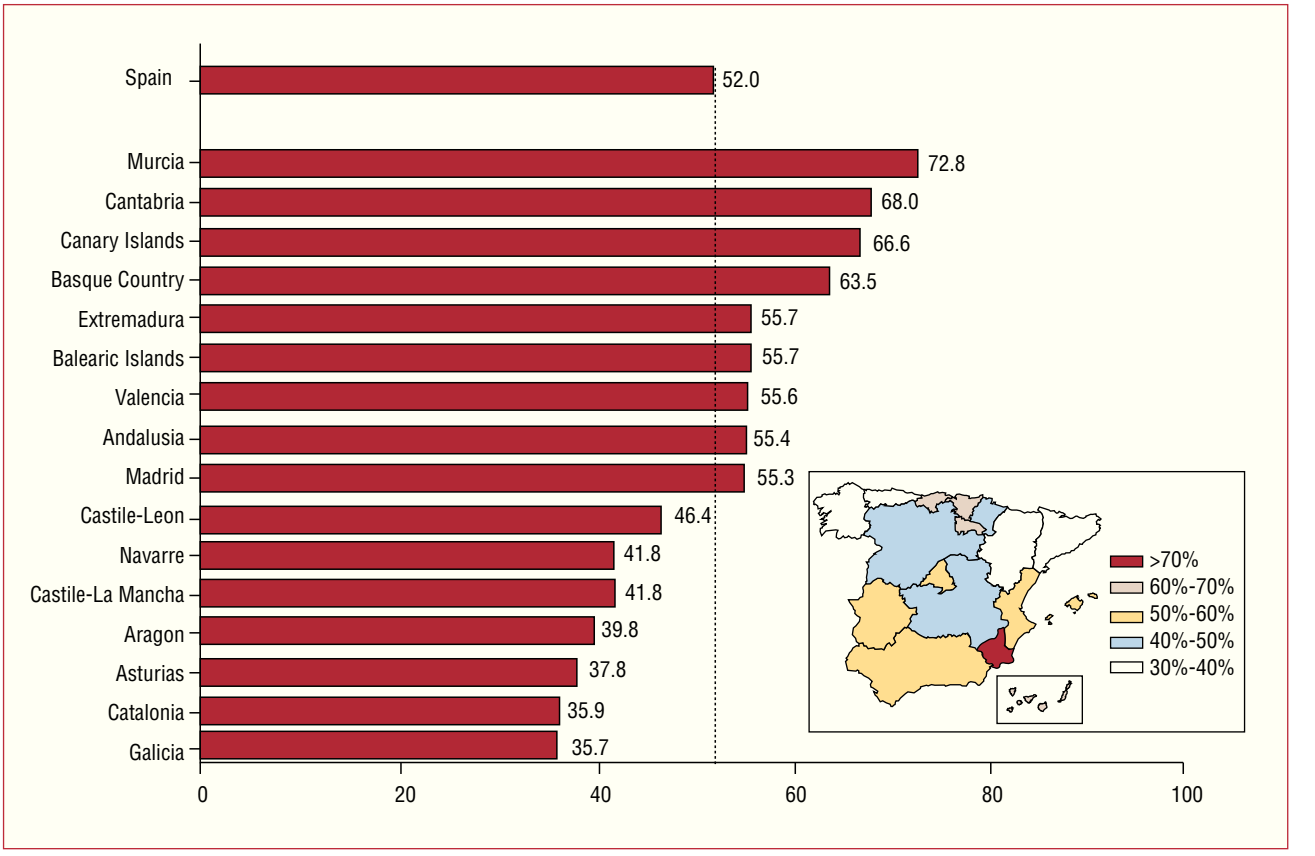


Figure 11. Distribution of the percentage of drug-eluting stents compared to the total number of stenting procedures by autonomous region.

Devices for extraction of thrombotic material, used in 1732 procedures (an increase of 43%), are also becoming more widespread. As in the previous year, the use of thrombus extraction devices continues to grow at a much faster rate than PCI for AMI, and the use of distal embolization protection devices increased by 20.8% (261 procedures). Alcohol septal ablation was carried out in 51 cases and fistula embolization in 19. Brachytherapy was only used in 10 procedures, all of which were for restenotic lesions, and was successful and free of complications in all cases.

Noncoronary Interventions in Adults

In 2005, 427 valvuloplasties were carried out in adults in 57 centers, thus maintaining the decrease of previous years (7% compared to 2004). This decrease occurred mainly because of the number of mitral valvuloplasties decreased by 9.7% from 391 to 354 (Figure 12). In addition, 14 aortic valvuloplasties and 29 lung valvuloplasties were carried out.

Atrial septal defects were closed with a percutaneous device in 345 patients. Compared to the decrease in these procedures observed between 2003 and 2004, this figure

TABLE 1. **Change in Stent Usage (1998-2005)**

	1998	1999	2000	2001	2002	2003	2004	2005
Centers (n)	70	80	87	94	93	102	100	114
Stenting procedures (n)	14 497	17 783	22 580	27 586	31 871	37 559	41 581	49 850
Units implanted (n)	19 378	22 946	29 504	39 356	47 249	57 778	68 892	80 569
Stents/procedure (n)	1.34	1.3	1.3	1.43	1.48	1.53	1.53	1.61
Cases with stents/total PCI (n)	61.5	71.9	77.3	88.1	91.7	92.5	91.4	96.4
Drug-eluting stents (n)	–	–	–	–	1906	11 699	25 148	41 352
Drug-eluting stents (%)	–	–	–	–	4.1	20.2	36.5	51.3
Direct stenting procedures (n)	–	–	8778	11 280	13 768	11 577	14 971	14 496
Direct stenting procedures (%)	–	–	38.9	40.9	43.2	30.8	32.9	28

PCI: percutaneous coronary intervention.

TABLE 2. **Change in Rotational Atherectomy, Directional Atherectomy, Cutting Balloons, Thrombectomy, and Distal Protection (1995-2004)**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Rotational atherectomy											
Procedures	330	367	554	549	473	461	445	426	349	450	460
Centers	23	18	33	36	32	28	33	27	26	33	40
Directional atherectomy											
Procedures	186	96	92	81	52	57	114	19	3	3	0
Centers	23	12	8	6	5	4	9	4	3	2	0
Cutting balloon	–	–	–	71	93	176	423	638	1079	1344	1475
Thrombectomy	–	–	6	10	4	108	329	499	743	1215	1732
Distal protection	–	–	–	–	–	10	43	200	200	216	261

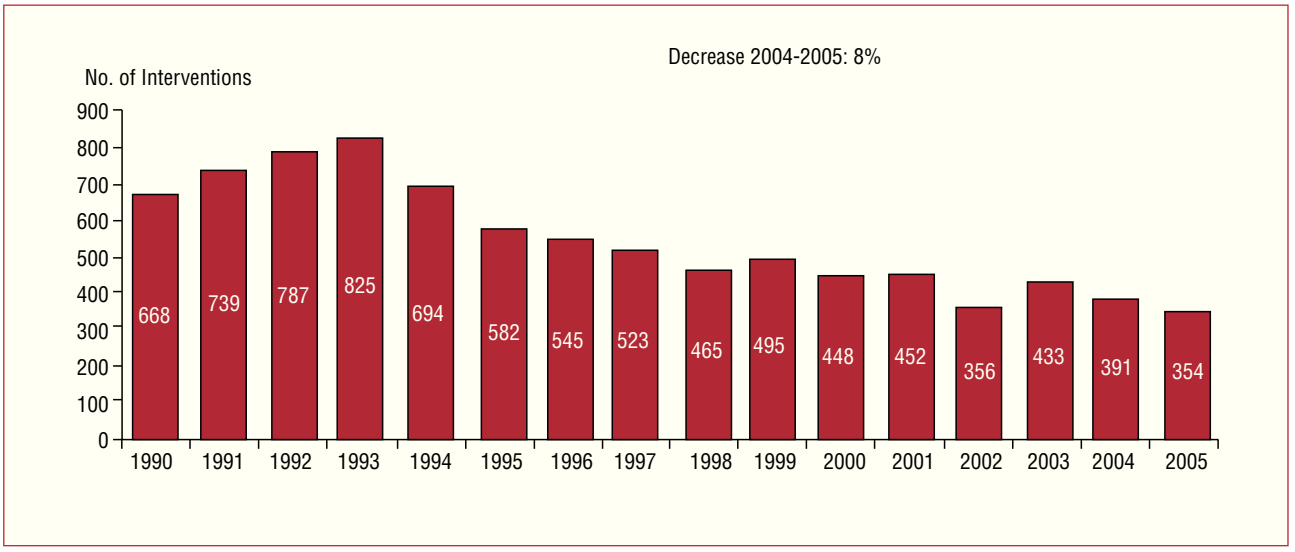


Figure 12. Change in the number of mitral valvuloplasty procedures between 1990 and 2005.

for 2005 represents a substantial increase of 40% compared to 2004. Success was achieved in 93% of the procedures, failure without complications was reported in 2.9%, and complications were reported in 4.1%. Four deaths were reported. There were 182 procedures to close patent foramen ovale and another 7 procedures in adult patients with congenital defects. Renal artery dilatations were carried out in 60 patients. In addition, 34 interventions for aortic coarctation, 10 for aneurysms of the abdominal aorta, and 48 for aneurysms of the thoracic aorta were done, as well as 53 percutaneous myocardial transplantations of stem-cells.

Percutaneous Coronary Interventions in Pediatric Patients

There were 1108 procedures in the pediatric age group in 21 centers, representing an increase of 1.7% compared to 2004; these included dilatations (322 cases), atrial septal defect closure (n=209), and ductus closure (n=186). The most widely used techniques are summarized in Figure 13.

CONCLUSIONS

The preparation and presentation of the annual report of the Cardiac Catheterization and Coronary Intervention Registry is one of the most important tasks of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology. Both the board members of the Working Group and its members consider the data presented in this registry to be of vital importance to professionals, health authorities, and the general public. The registry is unique within Europe because of its comprehensive up-to-date nature and the quality of the data collected. It therefore provides a valuable overview of an important aspect of cardiovascular disease and should ensure better assignment of health care resources in this field.

In 2005, the diagnostic and therapeutic activity for infarction continued to increase, although the increases are beginning to level off. The radial approach was used in more than 25% of the diagnostic and therapeutic procedures in 2005. Despite these increases, most measures of diagnostic and interventional resource use remain clearly lower than those of the most developed

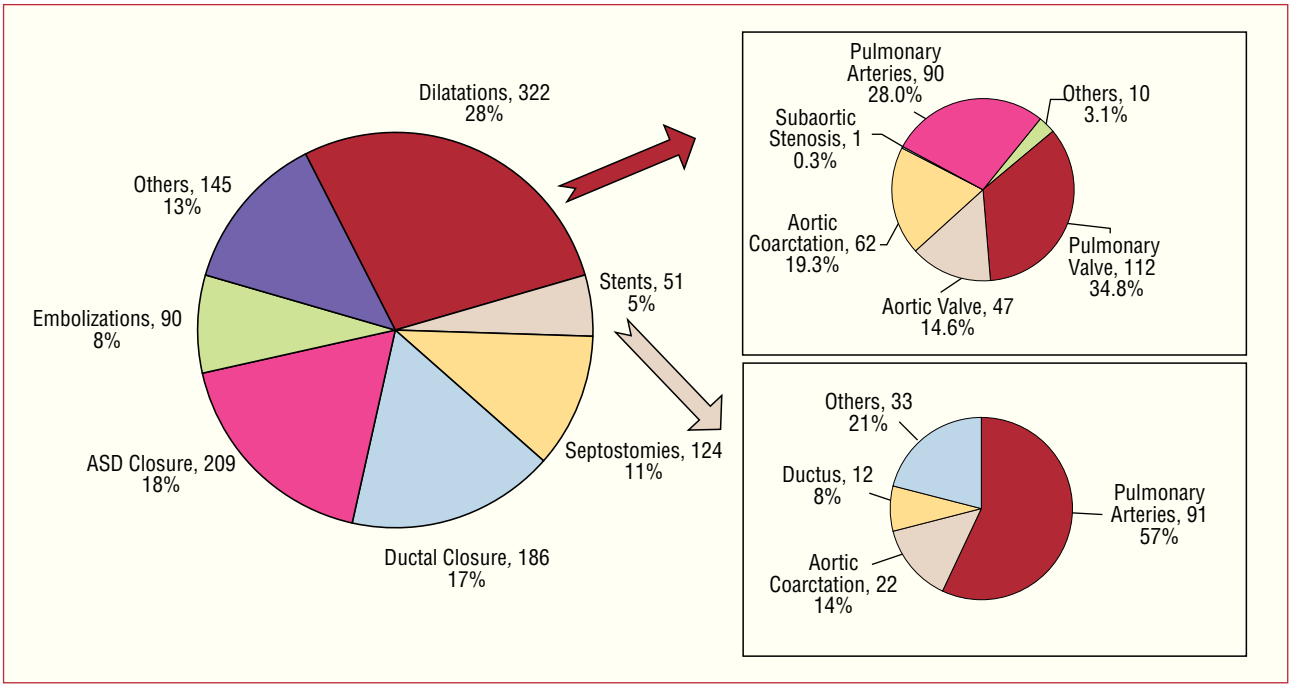


Figure 13. Distribution of pediatric procedures.
ASP indicates atrial septal defect.

European countries, especially if we take into account that we are comparing our data with data 2 years out of date without accounting for growth in these countries in the intervening period. There is still a lot of variation among the various Spanish autonomous regions regarding diagnostic activity and different aspects of treatment. Although drug-eluting stents are used in more than 65% of all stenting procedures in some autonomous regions, use of these stents in other regions remained below 40% in 2005. The national average for use of this type of stent was 52%.

The decrease in the number of mitral valvuloplasties seen in the previous year also occurred this year. All percutaneous closures of atrial septal defects such as patent foramen ovale increased notably in 2004. The extent of interventional activity in pediatric patients was almost the same as in 2004.

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. Gómez-Recio M, Martínez Elbal L, 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, Elizaga 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;51:927-38.
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, Duran 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, Duran 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, Duran 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 Antolín R. Registro Español de Hemodináica y Cardiología Intervencionista. XIV Informe Oficial de la Sección de Hemodinamica y Cardiología Intervencionista de la Sociedad Española de Cardiología (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. XV Informe Oficial de la Sección de Hemodinamica y Cardiología Intervencionista de la Sociedad Española de Cardiología (1990-2004). Rev Esp Cardiol. 2005;58:1318-34.
15. Maier W, Abay M, Cook S, Togni M, Zeiher A, Meier B. The 2002 European registry of cardiac catheter interventions. Int J Cardiol. 2005. [Epub ahead of print].
16. Cook S, Togni M, Walpoth N, Maier W, Muehlberger V, Legrand V, et al. Percutaneous coronary interventions in Europe 1992-2003. Eurointervention. 2006;1:374-81.
17. Windecker S, Maier-Rudolph W, Bonzel T, Heyndrickx G, Lablanche JM, Morice MC, et al. Interventional cardiology in Europe 1995. Working Group Coronary Circulation of the European Society of Cardiology. Eur Heart J. 1999;20:484-95.
18. Togni M, Balmer F, Pfiffner D, Maier W, Zeiher AM, Meier B. Percutaneous coronary interventions in Europe 1992-2001. Eur Heart J. 2004;25:1208-13.
19. Maier W, Camici P, Windecker S, Pfiffner D, Wijns W, Meier B. The European Registry of Cardiac Catheter Interventions 1997. Eur Heart J. 2002;23:1903-7.
20. Rotter M, Pfiffner D, Maier W, Zeiher AM, Meier B. Interventional cardiology in Europe 1999. Eur Heart J. 2003;24:1164-70.
21. 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.
22. lvarez-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.
23. Silber S, Albertsson P, Aviles FF, Camici PG, Colombo A, Hamm C, et al. Guias de Práctica Clínica sobre intervencionismo coronario percutáneo. Rev Esp Cardiol. 2005;58:679-728.

APPENDIX 1. **Data Collection Questionnaire for the Registry**

1. Center Information
   - 1.1 *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 Type of position ..... Full time/part time
     - 1.11.2 Name of cardiologist 2
       - 1.11.2.1 Type of position ..... Full time/part time
     - 1.11.3 Name of cardiologist 3
       - 1.11.3.1 Type of position ..... Full time/part time
     - 1.11.4 Name of cardiologist 4
       - 1.11.4.1 Type of position ..... Full time/part time
     - 1.11.5 Name of cardiologist 5
       - 1.11.5.1 Type of position ..... Full time/part time
     - 1.11.6 Name of cardiologist 6
       - 1.11.6.1 Type of position ..... Full time/part time
     - 1.11.7 Name of cardiologist 7
       - 1.11.7.1 Type of position ..... Full time/part time
     - 1.11.8 Name of cardiologist 8
       - 1.11.8.1 Type of position ..... Full time/part time
2. Laboratory Information
   - 2.1 *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-hour emergency service
   - 2.7 *Cardiovascular surgery available at the center
   - 2.8 *Activity database available
3. Diagnostic Procedures
   - 3.1 *Total number of diagnostic procedures
     - 3.1.1 *Number of coronary angiograms
       - †3.1.1.1 Number of coronary angiograms in women
       - †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 Other
   - 3.2 Number of procedures with radial approach

*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).

†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 guidewire only counts as a coronary angiogram (3.1.1) and, logically, a single diagnostic procedure (3.1) would also count as a pressure guidewire 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*
- 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†
- 5.5 Number of procedures with at least one saphenous vein graft
- 5.6 Number of procedures with at least one 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‡
- 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 Hospital death
- §5.16 Number of coronary interventional procedures in women
- §5.17 Number of coronary angiograms in patients aged 75 years or more

*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.

† At least 1 of the treated lesions in a session is restenotic.

‡ 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.)

§If the information is not available, leave the box blank.

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 *Total number of diagnostic procedures for AMI
  - 7.1.1 Primary PCI*
  - 7.1.2 Rescue PCI†
  - 7.1.3 Facilitated PCI
    - 7.1.3.1 Immediate facilitated PTCA‡
    - 7.1.3.2 Delayed facilitated PTCAII
  - 7.1.4 Approximate percentage of primary PCI with respect to total AMI
- 7.2 Outcomes of PCI for AMI (overall, including cardiogenic shock)

7.2.1 Success without complications
7.2.2 Failure without major complications
7.2.3 Number of procedures with major complications
7.2.4 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 Hospital death
7.10 Number of procedures done with radial approach
§7.11 Number of procedures for AMI in women
§7.12 Number of procedures for AMI in patients aged 75 years or more
*PTCA performed during acute phase of AMI (first 12 h) without any prior thrombolytic therapy.
†PTCA performed during acute phase of AMI after thrombolytic therapy due to clinical suspicion of reperfusion failure of thrombolytic therapy.
‡PCI performed electively in the first 3 hours after administration of thrombolytic therapy and a platelet IIb/IIIa antagonist.
IIPCI performed electively between 3 and 24 hours after successful administration of thrombolytic therapy and a platelet IIb/IIIa antagonist.
§If the information is not available, leave the box blank.

8. Coronary Stenting
8.1 Total number of procedures*
8.2 Total number of stents implanted
8.3 Number of stents implanted without predilatation
8.4 Total number of procedures without predilatation†
8.5 Total number of drug-eluting stents
*The procedure is defined in the same way as the interventional procedure (5.1) was defined.
†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
*These include procedures for 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 Dilatation of renal arteries

11. Percutaneous vascular closure devices
11.1 Percutaneous closure devices
11.1.1 With collagen
11.1.2 With suture
11.1.3 Other

12. Brachytherapy

- 12.1 Total number of procedures
  - 12.1.1 Beta radiation
  - 12.1.2 Gamma radiation
- 12.2 Total number of lesions
  - 12.2.1 De novo
  - 12.2.2 Restenotic
- 12.3 Initial outcomes without complications
  - 12.3.1 Total number of successful procedures
  - 12.3.2 Total number of failed procedures without complications
  - 12.3.3 Total number of mayor complications
    - 12.3.3.1 Death
    - 12.3.3.2 Nonfatal AMI
    - 12.3.3.3 Surgery

13. 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 Complications
    - 14.1.3.1 Death
    - 14.1.3.2 Others
- 14.2 Number of procedures for aortic coarctation
- 14.3 Number of procedures to close patent foramen ovale
- 14.4 Other procedures in adults with congenital heart disease (specify):
- 14.5 Specification of other procedures:

15. Therapeutic Procedures in Pediatric Patients
- 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 of:
  - 15.2.1 Pulmonary arteries
  - 15.2.2 Aortic coarctation
  - 15.2.3 Ductus

APPENDIX 2. **Registry of the Working Group on Cardiac Catheterization and Interventional Cardiology Laboratories Participating in 2005**

Andalusia
- Almería
  - Hospital Torrecárdenas
- Cadiz
  - *Clínica Asisa Jerez*
  - *Clínica Nuestra Señora de la Salud*
  - Hospital de Jerez de la Frontera
  - Hospital Universitario de Puerto Real
  - Hospital Universitario Puerta del Mar
- Cordoba
  - Hospital Universitario Reina Sofía y Cruz Roja
- Granada
  - Hospital Universitario Virgen de las Nieves
- Huelva
  - Hospital Juan Ramón Jiménez
- Jaén
  - Complejo Hospitalario Ciudad de Jaén
- Malaga
  - *Clínica El Ángel*
  - *Clínica Parque San Antonio Clínica Santa Elena*
  - *Clínica USP Marbella*
  - Complejo Hospitalario Carlos Haya
  - *Hospital Costa del Sol Marbella*
  - Hospital Universitario Virgen de la Victoria
- Seville
  - Hospital de Valme
  - Hospital Universitario Virgen del Rocío
  - Hospital Universitario Virgen Macarena

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

Canary Islands
- Las Palmas
  - *Clínica San Roque*
  - Hospital de Gran Canaria Dr. Negrín
  - Hospital Universitario Insular de Gran Canaria
- Tenerife
  - Complejo Hospitalario Nuestra Señora de la Candelaria
  - Hospital Universitario de Canarias
  - *Hospiten Rambla*

Cantabria
- Santander
  - Hospital Universitario Marqués de Valdecilla

Castille-Leon
- Burgos
  - Hospital General Yagüe
- León
  - Hospital de León
- Salamanca
  - Hospital Universitario de Salamanca
- Valladolid
  - *Hospital Campo Grande*
  - Hospital Universitario de Valladolid

Castille-La Mancha
- Albacete
  - Hospital General de Albacete
  - *Ibérica de Diagnóstico y Cirugía*
- Guadalajara
  - Hospital General de Guadalajara
- Toledo
  - Hospital Virgen de la Salud

Catalonia
- Barcelona
  - *Centre Cardiovascular Sant Jordi*
  - *Centro Médico Teknon*
  - Ciutat Sanitària i Universitària de Bellvitge. L'Hospitalet de Llobregat
  - *Clínica Corachan*
  - *Clínica Quirón*
  - Hospital Clínic y Provincial de Barcelona
  - *Hospital de Barcelona. SCIAS*
  - Hospital de la Santa Creu i Sant Pau
  - *Hospital del Mar*
  - *Hospital General de Catalunya*
  - Hospital General Vall d'Hebron
  - *Hospital Universitari Sagrat Cor*
  - Hospital Universitario Germans Trias i Pujol. Badalona
  - *Mutua Tarrasa*
- Girona
  - Hospital Dr. Josep Trueta
- Tarragona
  - Hospital Juan XXIII

Madrid Autonous Region
- *Centro Médico Zarzuela*
- *Clínica La Luz*
- *Clínica La Paloma*
- *Clínica Moncloa*
- *Clínica Montepríncipe*
- *Clínica Nuestra Señora de América*
- *Clínica Ruber*
- *Clínica Sur-Alcorcón*
- Fundación Hospital de Alcorcón
- *Fundación Jiménez Díaz*
- Hospital Clínico San Carlos-Complejo Hospitalario
- Hospital de La Princesa
- Hospital General Universitario Gregorio Marañón
- Hospital Militar Gómez Ulla
- Hospital Puerta de Hierro
- Hospital Ramón y Caja
- *Hospital Ruber Internacional*
- Hospital Universitario 12 de Octubre
- Hospital Universitario La Paz
- Instituto de Cardiología de Madrid
- *Sanatorio El Rosario*
- *Sanatorio La Milagrosa*

Navarre Autonomous Regions
- Navarre
  - *Clínica Universitaria de Navarra*
  - Hospital de Navarra

Valencia Autonomous Region
- Alicante
  - *Clínica del Levante*
  - *Hospital Clínica Benidorm*
  - Hospital de San Juan
  - Hospital General Universitario de Alicante
- Hospital General Universitario de Elche
- *Hospital USP San Jaime. Torrevieja*
- *Sanatorio Perpetuo Socorro*

Castellón
Hospital General de Castellón
Valencia
Clínica Casa de Salud
Hospital Clínico Universitario de Valencia
Hospital de la Ribera. Alzira
Hospital General Universitario de Valencia
Hospital Nueve de Octubre. GESNOU S.A.
Hospital Universitario Dr. Peset
Hospital Universitario La Fe
Hospital Virgen del Consuelo
Extremadura
Badajoz
Hospital Universitario Infanta Cristina
Cáceres
Clínica Virgen de Guadalupe
Galicia
La Coruña
Complejo Hospitalario Juan Canalejo
Complejo Hospitalario Universitario de Santiago de Compostela
Hospital POVISA
Hospital de Meixoeiro. MEDTEC. Vigo
Instituto Médico-Quirúrgico San Rafael
Pontevedra
Sanatorio Quirúrgico Modelo
Balearic Islands
Palma de Mallorca
Clínica Juaneda
Clínica Palmaplanas
Clínica Rotger
Hospital Universitario Son Dureta
Policlínica Miramar
Ibiza
Policlínica El Rosario

Basque Country
Álava
Hospital Txagorritxu. Vitoria
Guipúzcoa
Policlínica Guipúzcoa. San Sebastián
Vizcaya
Clínica V. San Sebastián. Bilbao
Hospital de Basurto. Bilbao
Hospital de Cruces. Baracaldo
Hospital de Galdakao. Galdakao
Asturias
Centro Médico de Asturias
Hospital Central de Asturias
Región de Murcia
Murcia
Clínica Nuestra Señora de la Vega
Hospital Santa María del Rosell. Cartagena
Hospital Universitario Virgen de la Arrixaca
Sanatorio San Carlos

Hospitals Specifically for Pediatric Patients
Barcelona
Hospital Sant Joan de Déu
Hospital Vall D'Hebron Infantil
Madrid
Hospital 12 de Octubre
Hospital La Paz Infantil
Hospital Ramón y Cajal
Hospital Universitario Gregorio Marañón
Malaga
Hospital Maternoinfantil. Complejo Carlos Haya
Murcia
Hospital Universitario Virgen de la Arrixaca
Seville
Hospital Virgen del Rocío
Valencia
Hospital Universitario La Fe