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Special article

Spanish Cardiac Catheterization and Coronary Intervention Registry. 21st Official Report of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology (1990-2011)

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ABSTRACT

Introduction and objectives: The Working Group on Cardiac Catheterization and Interventional Cardiology presents a yearly report on the data collected for the national registry. This information shows how procedures are distributed throughout Spain and makes comparisons with other countries feasible.
Methods: Institutions provided their data voluntarily (online) and were analyzed by the Working Group's Steering Committee.
Results: Data were provided by 108 hospitals (72 public and 36 private) that mainly treat adults, covering 138 480 diagnostic procedures, 123 746 of which were coronary angiograms, slightly more than the year before, with a rate of 3008 coronary angiograms per million population. Percutaneous coronary interventions decreased slightly to 63 202 procedures with a rate of 1373 interventions per million population. Of the 94 701 stents implanted, 61% were drug-eluting stents. In the acute phase of myocardial infarction, 15 491 coronary interventions were performed, 9.4% more than in 2010, representing 24.6% of the total number of coronary interventions. The most frequent intervention for adult congenital heart disease was atrial septal defect closure (298 procedures). Percutaneous mitral valvuloplasty continued to decrease (286 procedures) and percutaneous aortic valve implantations increased, but at a slower pace than in the previous year, with 770 units implanted in 2011.
Conclusions: The greatest increase in activity has occurred in the field of myocardial infarction and percutaneous aortic valve implantation. The number of other procedures, both diagnostic and therapeutic, remained stable.

Registro Español de Hemodinámica y Cardiología Intervencionista. XXI Informe Oficial de la Sección de Hemodinámica y Cardiología Intervencionista de la Sociedad Española de Cardiología (1990-2011)

Palabras clave:
Registro
Cateterismo cardiaco
Stent
Válvula aórtica percutánea

RESUMEN

Introducción y objetivos: La Sección de Hemodinámica y Cardiología Intervencionista presenta su informe anual con los datos del registro de actividad nacional correspondientes a 2011. Esta información permite saber la distribución nacional del intervencionismo cardiaco y ofrece datos para compararse con otros países.
Métodos: Los centros proporcionan sus datos voluntariamente. La información se introduce *online* y la analiza la Junta Directiva de la Sección de Hemodinámica.
Resultados: Enviaron sus datos 108 hospitales (72 centros públicos y 36 privados), que realizan su actividad predominantemente en adultos. Se realizaron 138.480 estudios diagnósticos (123.746 coronariografías), con ligero aumento respecto al año anterior y una tasa de 3.008 coronariografías/millón de habitantes. Los procedimientos intervencionistas coronarios se redujeron ligeramente hasta 63.202, con una tasa de 1.373 intervenciones/millón de habitantes. Se implantaron 94.701 *stents* (el 61% farmacoactivos). Se llevaron a cabo 15.491 procedimientos en el infarto agudo de miocardio, lo que supone un incremento del 9,4% respecto a 2010 y representa el 24,6% del total de intervenciones coronarias percutáneas. El intervencionismo más frecuente en las cardiopatías congénitas del adulto fue el cierre de la comunicación interauricular, con 298 procedimientos. La valvuloplastia mitral sigue en descenso, con 286 casos. El implante percutáneo de válvulas aórticas sigue creciendo, aunque más moderadamente, con un total de 770 unidades implantadas en 2011.

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Conclusiones: El aumento más importante en la actividad ha tenido lugar en relación con el infarto con elevación de ST y el implante percutáneo de válvulas. Los demás procedimientos tanto diagnósticos como terapéuticos se mantienen en fase de meseta.

Abbreviations

AMI: acute myocardial infarction
PCI: percutaneous coronary intervention

INTRODUCTION

Another year has passed and we continue an annual tradition founded in 1990. One of the most important tasks of the Steering Committee of the Working Group on Cardiac Catheterization and Interventional Cardiology is to collect data on the activity of as many cardiac catheterization laboratories as possible to complete the annual registry of activity. In recent years, data collection has steadily improved[1–20] due to introducing data online; over the last 2 years, 100% of the hospitals have provided their data. Data cleaning was performed by the steering committee and its members; the preliminary data were presented at the annual meeting of the working group, which this year was held on June 14-15 in Santander (Spain). The data are also available at the working group's website.[21]

The quality of information obtained provides an overview of the current situation in Spain and makes comparisons with other countries feasible. It also offers a way to assess and compare the development of interventional cardiology in Spanish autonomous communities. The free availability of these data helps in understanding the distribution of resources and in assessing the different trends in the use of diagnostic and therapeutic procedures.

In 2011, the severe economic crisis affecting Europe in general, and Spain in particular, appears to have influenced the evolution of interventional cardiology in the country, clearly limiting the use of resources which, in the case of our specialty, are relatively expensive. In recent years, percutaneous coronary intervention (PCI) has entered a plateau phase with minimal growth; this was negative in 2011 because for the first time the number of angioplasties decreased. However, there has been a continuing increase—already observed in the 2 previous years—of PCI, especially primary angioplasty, in the setting of infarction. There are probably several reasons for this increase, but it may well have been influenced by the European "Stent for Life" initiative,[22] which has the aim of improving the treatment of infarction and has named Spain as one of its "target" countries.[23] In fact, this year several Spanish regional governments have joined this initiative, which has entailed a significant increase in the number of primary PCI procedures. Finally, the geometric increase in percutaneous aortic valve replacement, both in the number of units implanted and the number of hospitals performing the technique, that was observed in 2010 has undergone a very clear slowdown, probably because of the economic recession.

This article presents the 21st report of interventional activity in Spain, covering the activity of all public hospitals and a significant number of private hospitals.

METHODS

We collected data on diagnostic and interventional cardiovascular procedures performed in most Spanish hospitals. Institutions provided their data on a voluntary basis without audit. Anomalous data or data with values outside trends in a given hospital in recent years were referred back to the researcher responsible for the hospital for their reassessment. Data were collected using a standard electronic questionnaire, which was accessed through the website of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology and completed online.[21] With the collaboration of the Persei company, the steering committee of the working group analyzed the data obtained, which are presented in this article, although a preliminary outline was presented as a slideshow at the working group's annual meeting.

Population-based calculations for Spain and each autonomous community were based on the size of the population estimated by the Spanish National Institute of Statistics up to December 31, 2011, as published on its website.[24] The Spanish population was estimated at 46 196 277 inhabitants (fig. 1). As in 2010, the procedures per million population for the entire country were based on the total population, because in previous years these rates were calculated based on averages from the different provinces in which interventional cardiology was conducted, rather than on the total population: although the differences may be small compared to previous years, the final result is closer to reality.

As in previous registries, a hospital was considered to be public that, regardless of its source of funding, had contracted to serve a specific area of the population within the public health system. Other hospitals were considered to be private.

RESULTS

Infrastructure and Resources

A total of 108 hospitals performing interventional procedures in adults participated in the present registry (5 fewer than the previous year); of these, 12 (2 more than in 2010) hospitals performed these procedures in pediatric patients (Appendix). All the public hospitals (72) and 36 of 110 private hospitals submitted their data, representing almost all the hospitals performing interventional procedures in Spain. There were 171 cardiac catheterization laboratories, of which 126 (74%) were in public hospitals; 35 hospitals had 2 laboratories and 7 had 3 or more. A 24-h emergency team was available in 69% of the hospitals and 63% performed cardiac surgery.

Regarding personnel, the 108 hospitals reported 438 physicians (339 of whom were accredited) who performed interventional procedures in 2011. There were 2.64 physicians per laboratory in public hospitals (333 physicians) and 2.33 per laboratory in private hospitals. There were 530 registered nurses and 93 radiology technicians, with a combined average of 3.90 per public hospital and 2.93 per private hospital.

Diagnostic Procedures

During 2011, 138 480 diagnostic procedures were performed, representing a 2.2% increase compared to the previous year. In total, 123 746 coronary angiograms were performed, which was 3.8% more than in 2010. Of these procedures, 23.5% were performed in women and 23.3% in patients over 75 years; these figures remain very stable from year to year. The national

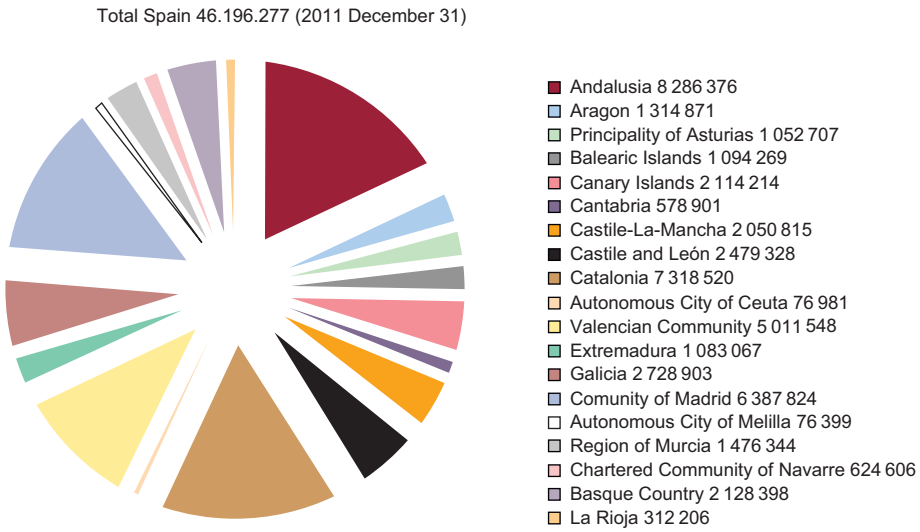
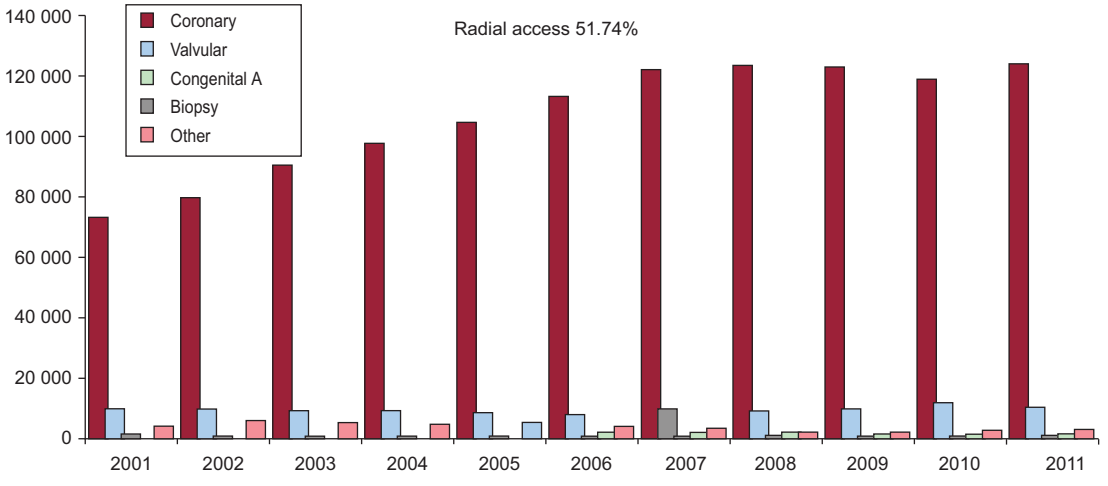


Figure 1. Population of Spain as of 31 December, 2011. Source: Spanish National Institute of Statistics.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Coronary	79 607	83 667	90 939	97 785	103 646	113 228	122 260	123 031	122 961	119 118	123 746
Valvular	9452	8225	9168	8738	7978	7901	9459	8884	9683	11 581	10 567
Biopsy						2164	1644	1720	887	1402	1118
Congenital A	531	570	613	701	721	741	787	761	1496	868	749
Other	5840	5027	5228	4227	4900	3923	3122	2062	2138	2517	2300
Total	95 430	97 609	105 939	111 451	117 245	126 196	136 231	136 458	137 166	135 486	138 480

Figure 2. Evolution of the number and type of diagnostic procedures performed between 2001 and 2011.

average was 3008 coronary angiograms per million population, which was higher than previous years. Compared to the 19.6% increase in the number of valvular procedures observed in 2010, this year there has been a 9% decrease.

Figure 2 shows the distribution of all diagnostic procedures performed since 2001.

Regarding diagnostic activity, 54 hospitals performed more than 1000 coronary angiograms (8 fewer than in 2010), of which only 12 performed more than 2000 (9 fewer hospitals than in the previous year) (fig. 3). There was an average of 1282 diagnostic procedures per hospital, which was virtually the same as in previous registries.[18,20] Of note, only 19 public hospitals (6 more than in 2010) performed fewer than 1000 coronary angiograms.

Figure 4 shows the national average of 3008 coronary angiograms per million population. Compared to the previous year, the difference (2359 procedures) between the region performing the most coronary angiograms and the region performing the fewest has increased. If we exclude the two most extreme

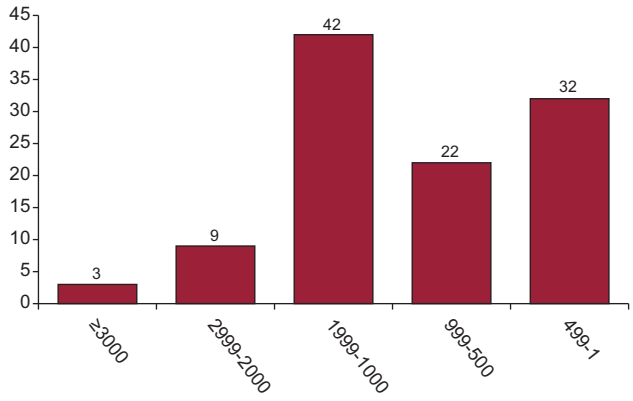


Figure 3. Distribution of hospitals according to the number of coronary angiograms.

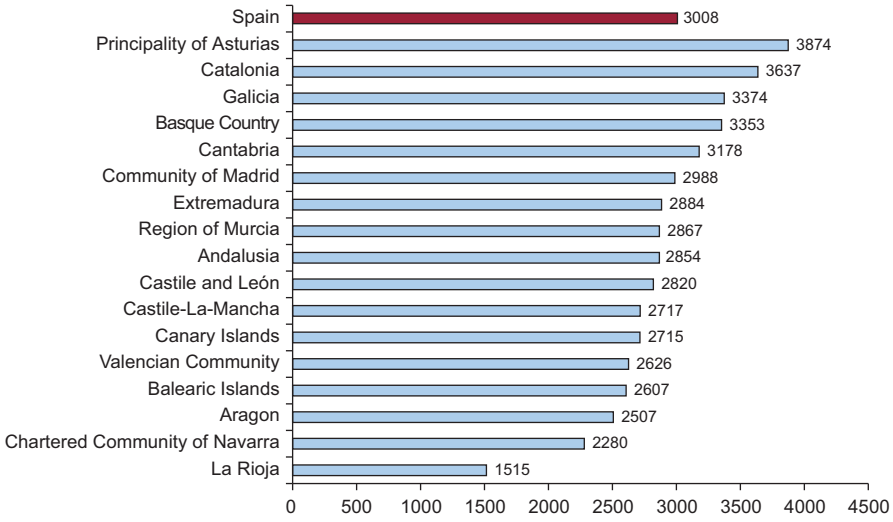


Figure 4. Distribution of coronary angiograms per million population and autonomous communities.

values, the sample is much more homogeneous, with a difference of only 1130 procedures.

Regarding intracoronary diagnostic techniques, for the first time there was a clear and significant decrease of 14% in the use of intravascular ultrasound, although it remains the most widely used technique. The use of pressure guidewire continued to steadily increase; last year the increase was 26.6%, whereas this year it was 22%, totaling 65% growth in the last 3 years. The use of optical coherence tomography remained exactly the same as last year. Figure 5 shows the evolution of the different intracoronary diagnostic techniques compared to last year.

Regarding access routes, the radial artery was used in 51.7% of cases, a figure similar to previous years, although this was 5% less than in 2010.

Percutaneous Coronary Intervention

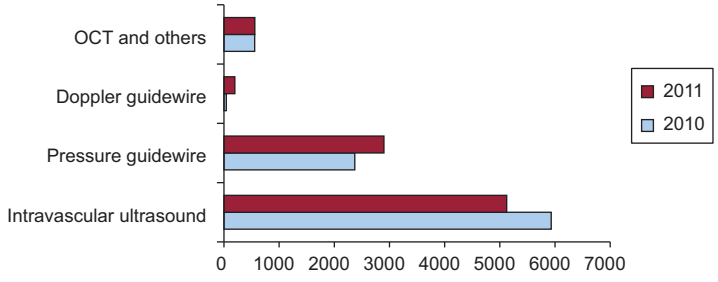
For the first time, there was a reduction in the number of PCI: 63 202 procedures were performed, 1129 less than in 2010, representing a 1.8% decrease. Figure 6 shows the historical development of PCI. The number of PCI per million population was 1373 which, compared to 1398 in 2010, represented a 1.8% decrease. All the hospitals that performed diagnostic procedures also performed PCI.

The ratio of PCIs to coronary angiographies was around 0.51 (0.54 in 2012). The number of procedures for multivessel disease remained very stable compared to the previous year, representing 25.8% of all PCIs; there was very little change (a 3% decrease) in the number of ad hoc procedures performed during diagnosis (74%).

The distribution by sex and age remained very similar to 2010, with 21.5% of PCIs performed in women and 24.7% in those over 75 years. Restenosis was treated by PCI in 5% of cases (5.3% in 2010).

Strikingly, there was a marked decrease in procedures involving the unprotected left main coronary artery; there were 1828 interventions, 20% fewer than the previous year (a return to the same levels as in 2008), representing 2.9% of total PCI. Use of PCI for unprotected left main coronary artery disease is discussed in the "Discussion" section. There were 952 and 153 interventions on the saphenous vein and mammary artery, respectively, which in both cases was fewer than in previous registries.

Glycoprotein IIb/IIIa inhibitors and adjunctive antithrombotic drug therapy were used in 11 081 procedures, representing 17.5% of PCI (4% less than the previous year): 64% were performed using



	2010	2011
Intravascular ultrasound	5931	5124
Pressure guidewire	2371	2900
Doppler guidewire	43	197
OCT and others	557	559

Figure 5. Evolution of the different intracoronary diagnostic techniques. OCT, optical coherence tomography.

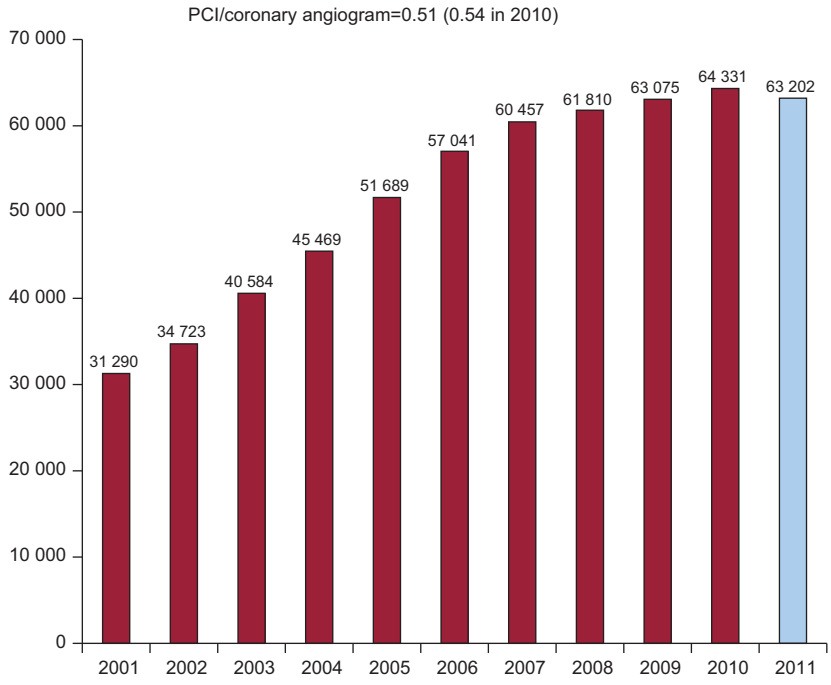


Figure 6. Evolution of the number of percutaneous coronary interventions performed between 2001 and 2011. PCI, percutaneous coronary intervention.

abciximab, 8% with tirofiban, 3% with eptifibatide, and 25% with bivalirudin; the use of bivalirudin continues to increase over previous years.

Figure 7 shows the distribution by Spanish autonomous communities of the 1373 PCIs per million population. The size of the difference (815) was maintained between 2009 and 2010, although if the 2 extremes are eliminated, the figure becomes more homogenous at 498. Regarding distribution per hospital (fig. 8), 50 hospitals performed fewer than 500 PCIs per year (46%), with most of the private hospitals being in this category. As in 2009 and 2010, there were 17 hospitals in the high-volume (>1000) category.

There was a clear difference in the use of intracoronary diagnostic techniques (intravascular ultrasound and pressure guidewire), which are mainly used to evaluate the severity of intermediate lesions or the results of intervention. The use of intravascular ultrasound decreased to 8.1% of interventions (1.1% less than in 2010), whereas there was a clear rise in the use of pressure guidewire to 4.6% of interventions (compared to 3.7% in 2010 and 2.5% in 2008).

Radial access in PCI grew by 7% to reach 55.5%, for the first time exceeding femoral access in PCI. Vascular closure procedures continued to decrease, with a total of 35 330 cases, almost 2000 fewer than the previous year. Collagen was used in 63% of the procedures, suture in 13%, and other devices in 24%.

Stents

Stents were implanted in 89% of all PCIs (5% less than in 2010), with 94 701 units implanted during 56 078 PCIs in 2011; this represented 7000 fewer units than in 2010 and more than 10 000 fewer than in 2009. Once again, the ratio of stents per patient decreased to 1.5 (1.56 in 2010 and 1.63 in 2009). The use of

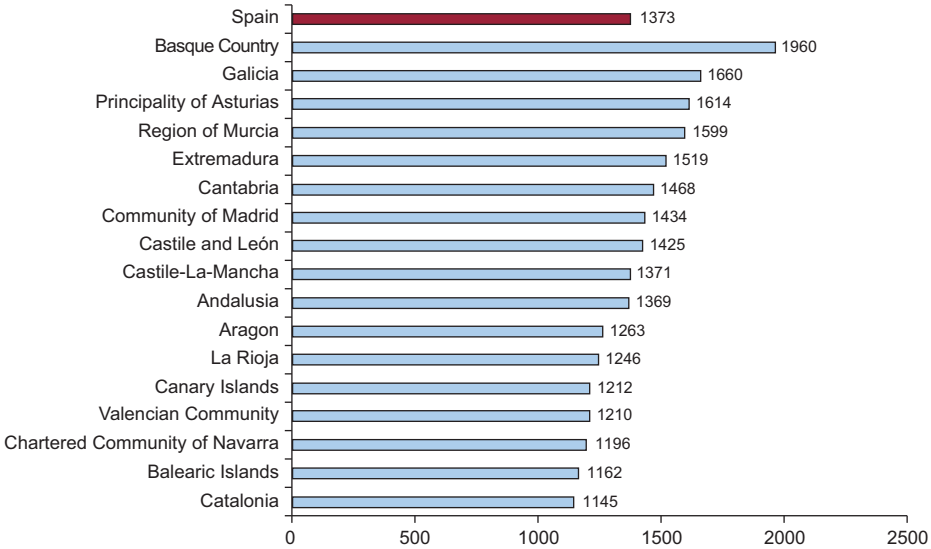


Figure 7. Distribution of percutaneous coronary interventions per million population and autonomous communities.

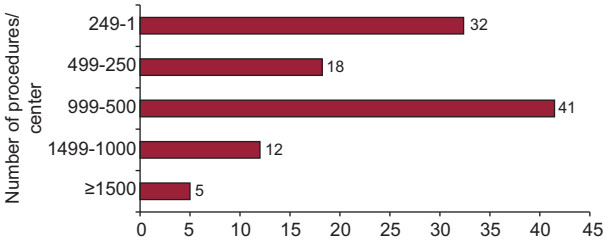


Figure 8. Distribution of hospitals according to the number of percutaneous coronary interventions performed in 2011.

drug-eluting stents remained completely stable at 61%, representing 58 211 units. Whether one type of stent or both were used depended on the characteristics of the patient and the target lesions; specifically, the percentage of procedures using drug-eluting stents alone was 35%, similar to 2009 and 2010, but almost 20% less than in 2008.

The use of drug-eluting stents continued to vary significantly between the Spanish regions. This year, more were used in the Basque Country (81.5%) then in Cantabria (79.7%), whereas the fewest (49%) were used in Galicia (fig. 9).

Other Devices and Percutaneous Coronary Intervention Procedures

The rate of increase in the use of rotational atherectomy slowed, with 1225 procedures compared to 1213 in the previous year. The use of directional atherectomy or intracoronary brachytherapy was not reported. Among other devices, the use of cutting balloons fell for the first time in recent years, being used in 1916 procedures in 2011 compared to 2092 procedures in 2010, a decrease of 9%. The spectacular growth in the use of thrombectomy catheters continued, with 8171 procedures in 2011, which was 16% more than in 2010 and almost 50% more than in 2009.

Intervention in Acute Myocardial Infarction

The 15 593 PCIs performed in the setting of acute myocardial infarction (AMI) represents a 9.4% increase compared to 2010, which was 6% higher than in 2009, and now represents 24.6% of all PCIs. Of the total number of procedures, 18.5% were performed in women and 20.7% in patients older than 75 years.

Within the range of PCI procedures in the acute phase of AMI, primary angioplasty continued to increase, the only approach to do so, increasing from 9334 in 2009 to 10 339 in 2012 and to 11 766 in 2011. In 2010, the Principality of Asturias, Castile-La-Mancha, Catalonia and the Region of Murcia led growth in the number of procedures, whereas this year the leading regions were the Principality of Asturias, the Valencian Community, Castile-La-Mancha, Castile and León, Andalusia and Aragon. Primary PCI accounted for 18.6% of all angioplasties and 76% of all infarct PCIs; the number of both facilitated PCIs and rescue PCIs slightly decreased (fig. 10).

The national distribution of PCI in AMI was similar to that of previous years; the best data were provided by those regions that had instituted a continuous care program for AMI (Figs. 11 and 12).

Regarding the number of procedures per center, 33 performed more than 200 infarct PCI per year (6 more than in 2010), whereas 33 performed less than 50 (7 less than the previous year) (fig. 13).

Noncoronary Interventions in Adults

Mitral valvulopasty remained the most frequent valvuloplasty (289 cases), although the steady yearly decrease in its use continued. The technique was performed in 54 of the 108 centers (Fig. 14). Aortic valvuloplasty continued to increase, albeit at a slower pace, with 173 procedures in 2011 compared to 146 in 2010. The growth in transcatheter aortic valve implantation continued, although more moderately, increasing from 426 in 2009 to 655 in 2010 and 770 in 2011 (48 hospitals performed the technique, 9 more than in 2010). Of these, 53% of the devices were self-expanding (92.7% were successful; hospital mortality was 5.3%) and 47% were balloon-expandable devices (92.7% were successful; hospital mortality was 5.3%).

The treatment of adult congenital heart disease remained the most frequent noncoronary intervention procedure, although the number of such procedures sharply decreased. In total, 565 procedures were performed (compared to 682 in 2010); the most common procedure was atrial septal defect closure (298 procedures; 97% were successful). There were major complications in 1.5% and another 1.5% were classified as failures without complications. Foramen ovale closure was performed in 195 cases (265 in 2010); 97% were successful and there was only 1 major

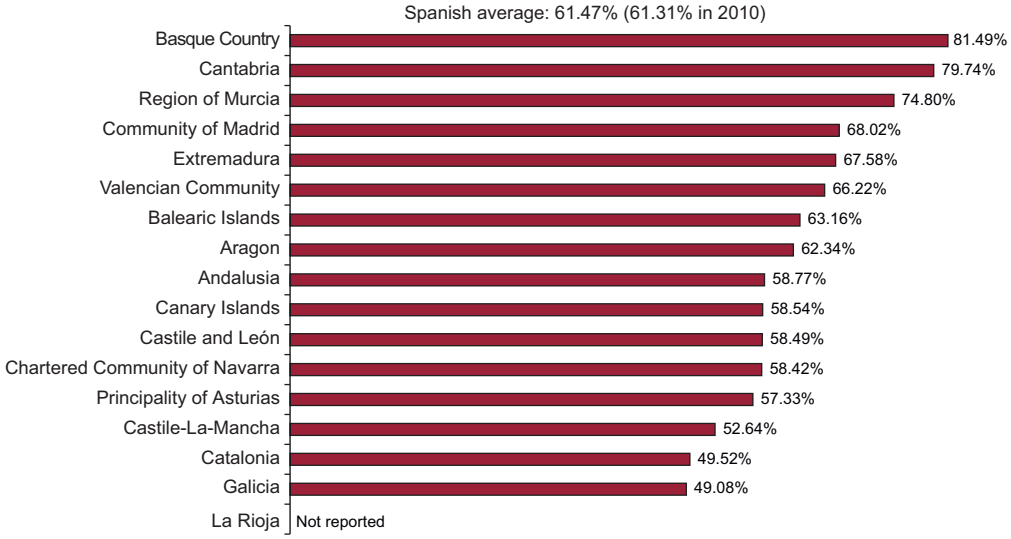
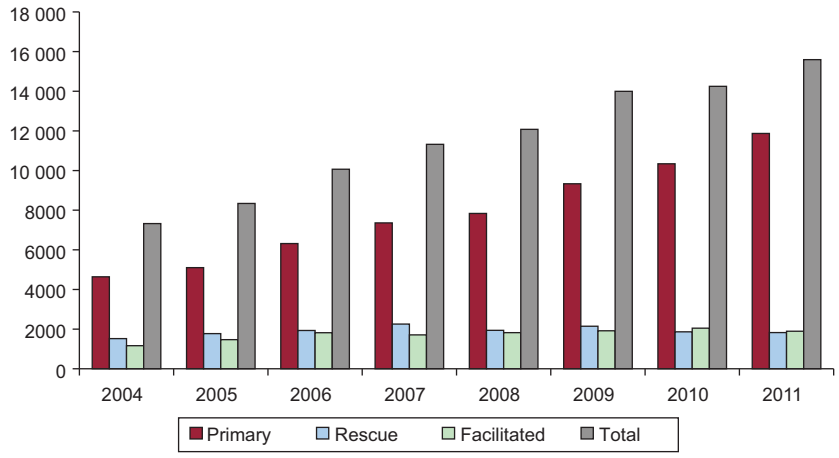


Figure 9. Distribution of antiproliferative drug-eluting stents as a percentage of all stents implanted per autonomous communities.



Primary	4640	5101	6316	7358	7837	9334	10 339	11 873
Rescue	1523	1772	1932	2253	1940	2145	1862	1825
Facilitated	1163	1468	1819	1711	1822	1916	2047	1895
TOTAL	7326	8341	10 067	11 322	12 079	13 995	14 248	15 593

Figure 10. Evolution of the types of percutaneous coronary intervention in acute myocardial infarction.

complication. In total, 32 procedures for aortic coarctation were performed (15 fewer than the previous year). Other procedures included the closure of ductus, ventricular septal defects, and fistulas. A total of 126 paravalvular leaks were treated, 12 more than in 2010.

Interventions in Pediatric Patients

Twelve hospitals provided data on their activity in pediatric patients (aged≤16 years), involving 48 septal closures and 92 ductus closures as the most common procedures.

DISCUSSION

The data collected on 2011 activity shows a trend towards the leveling out or a slight decrease in both diagnostic and interventional activity, and only shows an increase in newer techniques, such as percutaneous aortic valve implantation, although this increase was less than in the previous year.

It should be noted that the data for this year's and last year's registries were collected online alone. Despite this, there was no reduction in the number of participating hospitals, particularly if we focus on public hospitals, which account for the bulk of the activity. Furthermore, the provision of human and material resources remained very stable in recent years, with the vast majority of interventional cardiologists being accredited (77%).

Diagnostic procedures increased slightly from 2945 coronary angiograms per million population to 3008. This is still well below the latest published figures for Europe for 2005, with an estimated 4030 coronary angiograms per million population[25] or the latest data referring to 2009 presented at the EuroPCR 2011 congress, which reported an average of more than 5500 coronary angiograms per million population.[26] A striking fact is that the

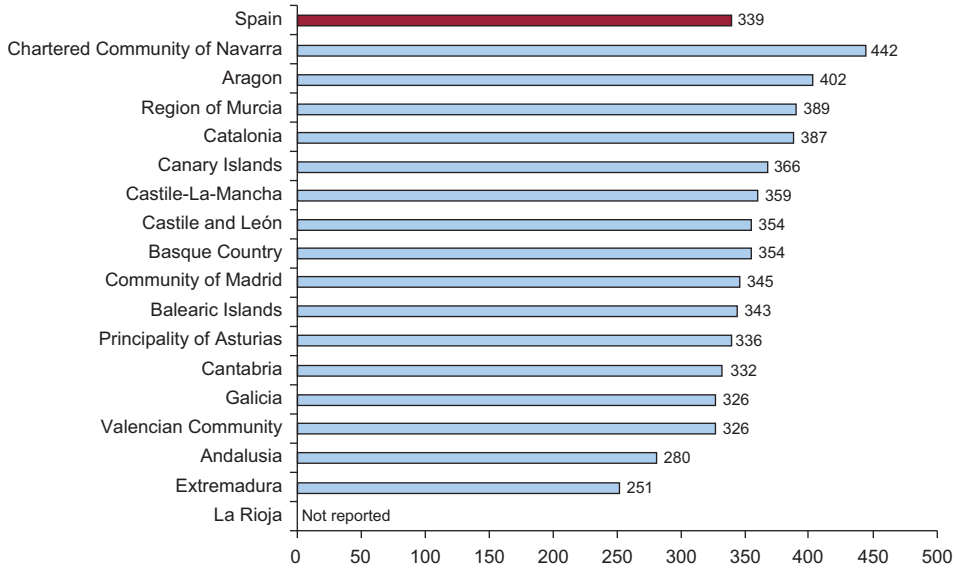


Figure 11. Distribution of percutaneous coronary interventions in acute myocardial infarction per million population and autonomous communities.

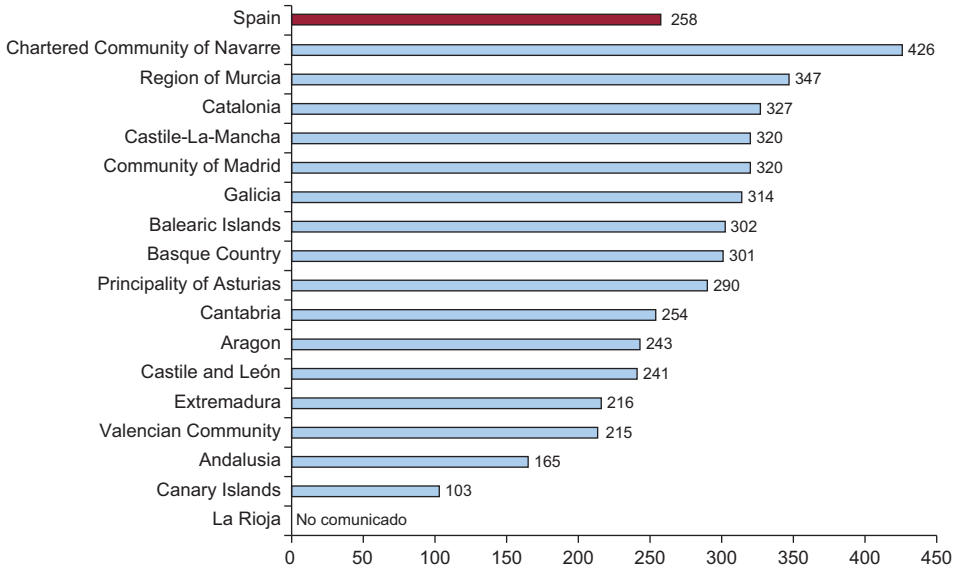


Figure 12. Distribution of primary angioplasties per million population and autonomous communities.

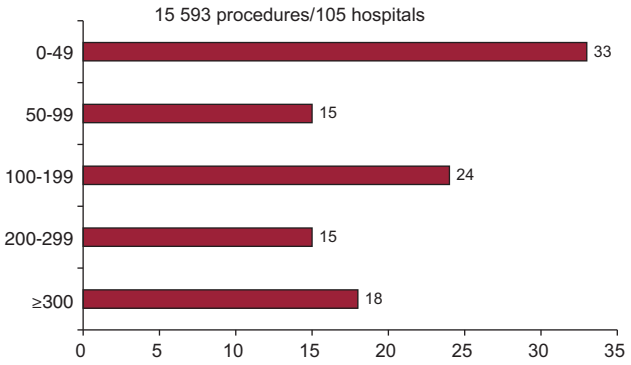


Figure 13. Distribution of hospitals according to the number of percutaneous coronary interventions acute myocardial infarction.

number of high-volume hospitals has slightly decreased, since 6 hospitals that performed more than 1000 coronary angiograms in 2010 have not done so this year; in fact, 19 public hospitals were recorded as performing fewer than 1000 coronary angiograms per year.

Regarding interventional procedures, for the first time there has been a decrease in the number of PCIs to around 63 202 procedures, which is more than 1000 fewer than the previous year. The decrease seems to have a multifactorial explanation. On the one hand, there has been no increase in diagnostic procedures, thus making an increase in interventionist procedures unlikely. On the other hand, it currently appears that some "complex" cases are not treated percutaneously, since there have been decreases in the number of stents implanted, the stent/patient ratio, and the number of special devices, such as rotational atherectomy or cutting balloon, used in these types of cases. In addition, there has been a marked increase in use of the pressure guidewire; as mentioned in the FAME study,[27] this tends to reduce the number of PCI procedures and the number of stents used. Finally, the long-term results of the SYNTAX trial[28] may also be contributing to the increase in the number of complex cases referred to bypass surgery. In this sense, the sharp decrease in the case of percutaneous treatment of the unprotected left main coronary artery is especially noteworthy. As a final note on PCI, we would like to draw attention to how different the situation is in Spain compared to the rest of Europe: the figure of

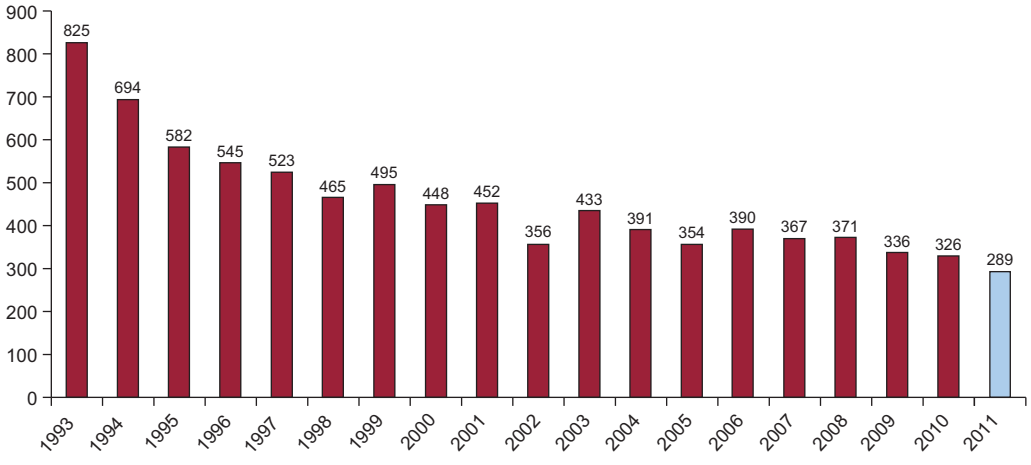


Figure 14. Evolution of mitral valvuloplasty in Spain.

1373 PCI procedures per million population in Spain is well below the latest European figure of 1601 PCI procedures per million population in 2005[25] or the nearly 2000 per million population in 2009.[26]

Among the most promising data in recent years, especially this year, is the improvement in the number of primary PCIs, which is clearly related to the implementation of the "Stent for Life" initiative of the European Society of Cardiology.[22] In fact, the recent article by Kristensen et al.[29] cites Spain as one of the countries with the best response to the initiative. Growth in primary PCI was 13.8%—and more than 20% in the last 2 years—whereas rescue or facilitated angioplasty slightly decreased. In fact, the increase in primary PCI is the reason the total number of PCIs has not changed very much. In addition, the increase in primary PCI explains the increased use of thrombectomy catheters and may also explain, at least partly, the decrease in the stent/patient ratio, since these procedures typically involve the use of just one stent. Although the situation has improved, we are still far from reaching the target of a "Stent for Life." Despite there being no data on the total number of AMI with ST-segment elevation cases in Spain, if the annual estimate was 45 000 AMI in Spain,[30,31] then primary PCI would be performed in only 20%; the aim of the "Stent for Life" initiative is to achieve primary PCI in 70% of AMI.[22]

Another encouraging fact is that percutaneous aortic valve implantation increased by 17.5%, although this represents a slowdown compared to the previous year, when the increase was 54%. The economic crisis could be having a strong impact on this area due to the high price of the devices. However, once the economic situation improves, together with probable reductions in the price of the devices due to the arrival of new competitors, the number of procedures in this area should begin to increase again in the future.

CONCLUSIONS

In the 2011 data we have seen a continuation of the leveling out or a slight decrease in the evolution of diagnostic and therapeutic procedures. Angioplasty procedures in the context of AMI continue to increase, especially primary PCI, due to the incorporation of new regions into primary PCI programs and to the marked increase in primary PCI in some hospitals. The "Stent for Life" program, which is a priority for the European Society of Cardiology, the Spanish Society of Cardiology, and our own working group, appears to be raising awareness among policy makers and medical professionals regarding the need to improve myocardial infarction care in Spain as a means to improve both the length and quality of life of coronary patients.

Differences remain between regions in the use of PCI in general and infarct PCI in particular.

Special mention must be made of percutaneous aortic valve implantation; despite a 17.5% increase in the number of procedures, growth was slower compared to the previous year.

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CONFLICTS OF INTEREST

None declared.

APPENDIX. HOSPITALS PARTICIPATING IN THE 2011 REGISTRY

Public hospitals	Private hospitals
Andalusia	
Complejo Hospitalario Torrecárdenas	Clínica Nuestra Señora de la Salud
Complejo Hospitalario Universitario de Jaén	Clínica Santa Elena, Estepona
Complejo Universitario Carlos Haya	Hospiten Estepona
Hospital Clínico Universitario Virgen de la Victoria	
Hospital Costa del Sol	
Hospital de Jerez de la Frontera	
Hospital Juan Ramón Jiménez	
Hospital Universitario de Valme	
Hospital Universitario Puerta del Mar	
Hospital Universitario Puerto Real	
Hospital Universitario Reina Sofía	
Hospital Universitario Virgen de las Nieves	
Hospital Universitario Virgen del Rocío	
Hospital Universitario Virgen Macarena	
Aragon	
Hospital Clínico Universitario Lozano Blesa	
Hospital Universitario Miguel Servet	
Principality of Asturias	
Hospital Central de Asturias	Centro Médico de Asturias
	Hospital de Cabueñes
Cantabria	
Hospital Universitario Marqués de Valdecilla	
Castile and León	
Hospital Clínico Universitario de Salamanca	Hospital Campo Grande (CEMIN)
Hospital Clínico Universitario de Valladolid	
Hospital de León	
Hospital General Yagüe	
Castile-La-Mancha	
Hospital General de Ciudad Real	
Hospital General Universitario de Albacete	
Hospital General Universitario de Guadalajara	
Hospital Virgen de la Salud	
Catalonia	
Ciutat Sanitària i Universitària de Bellvitge	Centre Cardiovascular Sant Jordi
Hospital Clínic i Provincial de Barcelona	Hospital General de Catalunya
Hospital de la Santa Creu i Sant Pau	Hospital Quirón Barcelona
Hospital del Mar	Hospital Universitari Mútua de Terrassa
Hospital General Universitari Vall d'Hebron	
Hospital Universitari Dr. Josep Trueta	
Hospital Universitari Germans Trias i Pujol	
Hospital Universitari Joan XXIII	

APPENDIX. *(Continued)*

Public hospitals	Private hospitals
Hospital Universitario Arnau de Vilanova	
Valencian Community	
Hospital Clínico Universitario de Valencia	Clínica Medimar, Alicante
Hospital de la Ribera, Alzira	Hospital Clínica Benidorm
Hospital General de Alicante	Hospital del Vinalopó
Hospital General de Castellón	Hospital IMED Levante
Hospital General Universitario de Elche	Hospital Perpetuo Socorro de Alicante
Hospital General Universitario de Valencia	Hospital San Jaime Torrevieja USP
Hospital Universitario Dr. Peset	UTE Torrevieja Salud
Hospital Universitario La Fe	
Hospital Universitario San Juan de Alicante	
Extremadura	
Hospital de Cáceres	
Hospital Universitario Infanta Cristina	
Galicia	
Complexo Hospitalario Universitario A Coruña	Instituto Médico Quirúrgico San Rafael
Complexo Hospitalario Universitario de Santiago	
Complexo Hospitalario Universitario de Vigo	
Balearic Islands	
Hospital Universitario Son Dureta	Clínica Juaneda
	Clínica Rotger
	Clínica USP Palmaplanas
	Policlínica Miramar
Canary Islands	
Hospital de Gran Canaria Dr. Negrín	
Hospital Universitario de Canarias, Tenerife	
Hospital Universitario Insular de Gran Canaria	
Hospital Universitario Nuestra Señora de Candelaria	
Hospiten Rambla	
Community of Madrid	
Hospital Central de la Defensa Gómez Ulla	Clínica Nuestra Señora de América
Hospital Clínico San Carlos	Clínica Ruber
Hospital de Torrejón	Fundación Jiménez Díaz
Hospital General Universitario Gregorio Marañón	Hospital La Moraleja (SANITAS)
Hospital Puerta de Hierro	Hospital La Zarzuela
Hospital Ramón y Cajal	Hospital Universitario Quirón Madrid
Hospital Universitario 12 de Octubre	Hospital de Madrid Norte Sanchinarro
Hospital Universitario de la Princesa	Sanatorio del Rosario de Madrid
Hospital Universitario Fundación Alcorcón	Sanatorio La Milagrosa
Hospital Universitario La Paz	
Region of Murcia	
Hospital Universitario Santa María del Rosell	Hospital San Carlos, Murcia
Hospital Universitario Virgen de la Arrixaca	Hospital Virgen de la Vega
Chartered Community of Navarre	
Hospital de Navarra	
Basque Country	
Hospital de Basurto-Basurtuko Ospitalea	Clínica Vicente San Sebastián
Hospital de Cruces	Policlínica Guipúzcoa
Hospital de Galdakao-Usansolo	
Hospital Txagorritxu	
La Rioja	
Hospital Viamed-Los Manzanos	

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