Introduction and objectives. Each year the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology reports on the data collected by the national registry of procedures performed. This report covers 2009. It contains information on the implementation of interventional cardiology across Spain and enables comparisons to be made with other countries.

Methods. Data were provided voluntarily and were analyzed by the Working Group’s steering committee.

Results. Data were submitted by 126 hospitals that mainly performed procedures in adults: 74 public and 52 private. Overall, 137,166 diagnostic procedures were carried out, including 122,961 coronary angiograms; the rate of 2,664 coronary angiograms per million population was little changed from the previous year. The number of percutaneous coronary interventions increased by 2% to reach 63,075, which corresponds to 1,391 per million population. In total, 102,850 stents were implanted (58.7% drug-eluting). In addition, 13,395 interventions were carried out during the acute phase of myocardial infarctions: this represents a 10% increase relative to 2008 and accounts for 21% of all percutaneous coronary interventions. The most frequent intervention for adult congenital heart disease was closure of an atrial septal defect, with 329 procedures. The most frequently performed valve procedure was mitral valvuloplasty, with 336 cases treated (success rate 96%), with the exception of percutaneous aortic valve implantation, which increased exponentially to a total of 426 in 2009.

Conclusions. The most significant increases in activity were in procedures for ST-segment elevation acute myocardial infarction and in percutaneous valve implantation. There was only a modest increase in the use of all other diagnostic and therapeutic procedures.

Key words: Registry. Cardiac catheterization. Stent. Atrial septal defect closure.
This paper presents the nineteenth report on interventional cardiology activity in Spain and covers public centers as well as the majority of private centers.

METHODS

Data was collected on diagnostic and interventional cardiology activity in the majority of Spanish centers. Data collection was voluntary and no audit is performed though researchers submitting very inconsistent data are required to re-assess it. Data is collected using a standard questionnaire which is distributed to all catheterization laboratories in the country in two ways: on paper, and as an electronic form provided via the website of the Spanish Society of Cardiology Working Group on Cardiac Catheterization and Interventional Cardiology (http://www.hemodinamica.com). The latter can be completed online. Paper versions are distributed and collected by the Izasa company. The data obtained was analyzed by the Board of the Working Group and is made public in this article.

For national and regional population-level calculations, the National Institute of Statistics’ (NIS) estimates for January 1, 2009 were used, as published on the NIS website (http://www.ine.es). The Spanish population stood at 46,157,222 inhabitants.

As in previous records, centers were defined as public, independently of its source of funding, if they served a certain population area within the public health system. All other centers were considered to be private.

RESULTS

Infrastructure and Resources

A total of 126 hospitals performing interventional activity in adults participated in the present registry. Of these, 9 also performed interventions in pediatric patients (Appendix 1). All of the public centers (74 hospitals) and 52 private centers (5 fewer than last year; it should be noted here that the registry does not include all of the private institutions carrying out interventional activity) submitted their data. Almost all of the centers performing interventional activity in Spain are therefore represented. The centers included provided a total of 178 catheterization laboratories, of which 112 (62%) were located in public health centers. A 24 hour emergency team was available in 73% of public centers and 75% of the private centers; 65% of the centers performed cardiac surgery.

The 126 participating centers reported that 432 doctors performed interventional activity during 2009, giving a distribution of 3.42 professionals per
In 2009, as in 2008, public centers performed 85% of diagnostic activity, with 55 centers performing over 1000 coronary angiograms, and 14 of them, over 2000 (Figure 2). Centers performed an average of 1,088 diagnostic procedures (770 per laboratory), so again were essentially unchanged from the previous 2 registries. Seventeen hospitals performed fewer than 1000 coronary angiograms.

As mentioned in the introduction, the national average was 2664 coronary angiograms per million inhabitants. Distribution by regions is shown in Figure 3. Apart from the region at the lowest end of the scale, the difference between the region with the highest rate and that with the second to lowest rate was only 818.

With regard to intracoronary diagnostic techniques, intravascular ultrasound was the most frequently used technique, followed by the pressure guide wire. With respect to previous years, there was some stagnation in the use of intravascular ultrasound (only a 3.4% increase in use compared to 2008), while the use of pressure guide wires increased by 17.7% (its use declined 14% in the previous year). Use of optical coherence tomography continued to increase, to a total of 327 interventions, representing an increase of 17% over 2008. On the other hand, use of the intracoronary Doppler guide wire decreased drastically, by 49.5%, to a total of only 52 cases. Figure 4 shows the evolution of intracoronary diagnostic techniques in recent years.

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Figure 1. Evolution of the number and type of diagnostic studies conducted between 1999 and 2009.
As regards accessory pathways, the increased use of the radial artery seen in previous years was maintained, and approached parity with the femoral artery. It was used in 45% of cases in 2009, compared to 48% in 2008 and 41.7% in 2007.

**Coronary Interventions**

The increase in percutaneous coronary interventions (PCI) was virtually identical to the previous year (2%), with the number in 2009 standing at 63,075. The historical development of the intervention in Spain is shown in Figure 5. The number of PCIs per million inhabitants was 1391, a slight increase over the previous year (1%) but still well below the latest published European figures, with a rate of 1601 PCIs per million inhabitants in 2005. 90% of coronary interventions were performed in National Health Service centers.

The PCI/angiography ratio was 0.51 in 2009, which represented a slight increase over 2008. This reflected...
the larger increase in the number of PCIs compared to coronary angiograms. The number of procedures for multivessel disease fell by 2.2% over the year and represented 24.8% of the total number of PCIs. The frequency of ad hoc procedures performed during diagnosis also remained unchanged at 76% (47 902).

Distribution by sex and age was very similar to 2008 with 19.8% of procedures performed in women (compared to 18.9% the previous year) and 23.3% of procedures performed in patients over 75 years of age (compared to 20% in 2008). In 5.6% of cases, PCI was performed on one or more restenotic lesions (5.2% in 2008). The number of interventions for restenotic lesions has been relatively stable for almost 5 years a fact which may be explained, at least in part, by the lack of any real increase in stent use over that period.

The significant increase in unprotected interventions in the common arterial trunk (CAT) is also noteworthy. The figure increased to 1973 operations, up 19% over the previous year, and representing 3.12% of total PCIs.
Radial access in coronary interventions increased slightly to 45.5% and, for the first time, reached similar proportions to its use in diagnosis (45%). As regards femoral access, vascular closure was used in 40,450 cases, 10% more than last year. Collagen was used in 66.7% of cases, compared to suture in 19.3%. Other devices were used in 14% of cases.

**Stents**

A stent was implanted in 94.8% of all coronary interventional procedures in 2009 (essentially the same proportion as in 2008), with a total of 102,850 units used in 59,834 PCIs. The mean number of stents per patient decreased to 1.63 (compared to 1.76 in 2008), which may be in part due to the increase in primary angioplasty in AMI compared with electives. The use of drug-eluting stents (DES) was almost identical to 2008 (58.7%), with 60,468 units employed. Use of a DES alone, as opposed to a bare metal stent alone or the two types of stent together, represented only 33.6% of the total number of procedures, almost 20% less than in 2008.

The use of DES varied substantially between regions and ranged from 77.8% in Cantabria to 46.8% in Castile-La Mancha (Figure 8).
Other Devices and Percutaneous Coronary Intervention Procedures

Use of rotational atherectomy continued to increase over the previous year, albeit discreetly (5.3%). There was no report of any directional atherectomy procedure or intracoronary brachytherapy. Among other devices, use of a cutting balloon increased dramatically (33%), to 1,784 procedures. The same was true for the thrombectomy catheter, which grew from 4427 cases in 2008 to 5481 in 2009.

Intervention in Acute Myocardial Infarction

A total of 13,395 procedures were performed in the context of AMI (21.2% of all PCI), an increase of 10% over 2008. Of those, 17.3% were performed in women (identical to 2008) and 21.5% were performed in individuals over 75 years of age, 1.5% more than in the prior year.

Among the range of PCI procedures performed in the acute phase of AMI, there was a marked increase in primary angioplasty, which increased
from 7837 procedures in 2008 to 9334 in 2009 (up 19%). A large part of this increase could be due to the incorporation of the metropolitan area of Barcelona, with more than 5 million inhabitants, within a primary angioplasty program which commenced in June 2009. Primary angioplasty accounted for some 15% of angioplasties and 65% of all infarct PCIs; 1916 (14.5%) were facilitated PCIs and 2145 (19.9%) were rescue PCIs (Figure 9).

National data on the total number of AMIs with ST elevation (STEMI) are not available, but given an annual estimate for Spain of 45000 STEMI,22,23 primary PCI would be used in only 20% of cases, whereas the ‘Stent for Life’ initiative recommends a target of 70% of primary PCIs in AMI.19

Nationwide distribution of PCIs in AMI shows a similar pattern to that observed in 2008, whereby autonomous communities with a continuous care program for AMI had the best data (Figures 10 and 11).

In terms of the number of procedures per center, only 23 performed over 200 angioplasties in AMI throughout the year, while 45 centers performed fewer than 50 (Figure 12).

Non-Coronary Interventions in Adults

Mitral valve replacement remained the most frequent non-coronary intervention (336 cases), with figures that were very similar to those of recent years. Outcomes were also the same as the previous year, with a success rate of 96% and major complications in 2% of procedures (Figure 13). Aortic valve replacement continued to increase, from 75 in 2008 to 134 in 2009. The growth in percutaneous aortic valve implantation was spectacular, from 151 cases in 2008 to 426 cases in 2009. Of these, 224 were self-expanding (94% success, with hospital mortality of 5.8%) and 202 used expandable balloons (90.5% success, with hospital mortality of 9.4%). The breakdown by regions is shown in Figure 14.

The treatment of adult congenital heart disease continued to be the most common non-coronary interventional procedure in the current registry, with 731 procedures performed (up from 635 in 2008). The most frequent of these was atrial septal defect (ASD) closure, with a total of 329 cases and a 96% success rate. Of the cases treated, 2% had complications, including device embolization or tamponade. Procedure mortality was zero, as in 2006, 2007 and 2008. Closure of the foramen ovale was performed in 232 cases, with a success rate of 98%, and 37 aortic coarctations were performed (14 more than the previous year). Other procedures performed included closure of ductus, ventricular septal defects, and fistula.

In all, 92 paravalvular leaks were treated, almost double the number treated in 2008; 66 were mitral and 26 aortic.

Interventions in Pediatric Patients

Ten centers provided data on their activity in pediatric age patients (16 years of age or under). These included 84 CIA closures and 52 ductus closures, 134 aortic valvuloplasties, 37 treatments for aortic coarctation, and 33 lung valvuloplasties.
Figure 10. Distribution of percutaneous interventions (PCI) in acute myocardial infarction (AMI) per million population and region.

Figure 11. Distribution of primary angioplasty per million population and regions.
Variations between the regions were maintained as regards PCI in general and, in particular, for myocardial infarction.

The use of ADES increased by only 0.5% compared to 2008, to a national average of 58.7%, with considerable variety between regions and a similar distribution to that observed in previous Registries.

The use of rotational atherectomy grew by only a small amount compared to growth recorded in the previous year (5.3% compared to 30.6%).

The radial accessory pathway was used in almost 50% of cases, both for diagnosis and in interventions and is used increasingly in the acute phase of stroke.

Moving beyond coronary interventions, percutaneous aortic valve implantation showed the strongest growth among all of the parameters examined, from 151 in 2008 to 426 in 2009. Of course, it may not be possible to maintain these levels of growth due to the economic situation in Spain and the high cost of these devices.

We would like to end by announcing the launch of a specific registry of percutaneous aortic valves and
our intention to set up, as soon as possible, another registry of activity based on individual patient data.

ACKNOWLEDGMENTS

The Board of the Working Group on Cardiac Catheterization and Interventional Cardiology would like to thank the directors and staff of Spain’s catheterization laboratories, and those responsible for data collection, for all the work which has made this Registry possible.

REFERENCES


Figure 14. Distribution of percutaneous aortic valve implantation by region.

APPENDIX 1. Hospitals Participating in the 2009 Registry

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Clínica Corachan
Clínica La Alianza – ANGIOCOR
Centro Médico Delfos

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Hospital Joan XXIII
Hospital Universitari Arnau de Vilanova
Hospital Puerta de Hierro
Hospital Universitario 12 de Octubre
Hospital Clínico San Carlos
Hospital Universitario de La Princesa
Hospital General Universitario Gregorio Marañón
Hospital Universitario La Paz
Hospital Militar Gómez Ulla
Hospital Ramón y Cajal
Fundación Hospital de Alcorcón
Fundación Jiménez Díaz
Cardioclinsa-Clinica Ntra. Sra. de América
Clínica Moncloa
Clínica Montepríncipe
Clínica Ruber
Hospital Ruber Internacional
Sanatorio La Milagrosa
Centro Médico Zarzuela
Clínica La Luz
Sanatorio el Rosario
Sanatorio La Paloma
Clínica Alcorcón Sur
Clínica La Moraleja
Clínica Quirón

Valencia
Hospital de Levante
Hospital de Torrevieja

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
Clínica Casa Salud

Lleida
Hospital Universitari Arnau de Vilanova

Madrid Region
Hospital Clínico Universitario Gregorio Marañón
Hospital General Universitario Gregorio Marañón
Hospital universitario San Juan de la Cruz
Hospital universitario de Elche
Hospital universitario Puerta de Hierro
Hospital universitario 12 de Octubre
Hospital universitario La Paz
Hospital militar Gómez Ulla
Hospital Ramón y Cajal
Fundación Hospital de Alcorcón
Fundación Jiménez Díaz
Cardioclinsa-Clinica Ntra. Sra. de América
Clínica Moncloa
Clínica Montepríncipe
Clínica Ruber
Hospital Ruber Internacional
Sanatorio La Milagrosa
Centro Médico Zarzuela
Clínica La Luz
Sanatorio el Rosario
Sanatorio La Paloma
Clínica Alcorcón Sur
Clínica La Moraleja
Clínica Quirón

Hospital Clínico Universitario de Madrid
Hospital Universitario La Paz
Hospital Militar Gómez Ulla
Fundación Hospital de Alcorcón
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Cardioclinsa-Clinica Ntra. Sra. de América
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Sanatorio La Milagrosa
Centro Médico Zarzuela
Clínica La Luz
Sanatorio el Rosario
Sanatorio La Paloma
Clínica Alcorcón Sur
Clínica La Moraleja
Clínica Quirón

Valencian Community
Alicante
Hospital General Universitario de Alicante
Hospital Universitario San Juan
Hospital General Universitario de Elche

Hospital Universitario de Elche
Hospital Clínico de Elche
Sanatorio Perpetuo Socorro
Clínica Benidorm
Clínica San Jaime de Torrevieja

Hospital General Universitario de Alicante
Hospital Universitario San Juan
Hospital General Universitario de Elche

Castellón
Hospital General de Castellón
Hospital Universitario Virgen de la Arrixaca

Región de Murcia
Hospital Santa María del Rosell
Clínica San Carlos
Clínica Virgen de la Vega

Extremadura
Badajoz
Hospital Universitario Infanta Cristina
Cáceres Hospital de Cáceres

Galicia
A Coruña
Complexo Hospitalario Universitario de A Coruña
Complexo Hospitalario Universitario de Santiago

Pontevedra
Complexo Hospitalario Universitario de Vigo
Hospital POVISA

Navarra
Hospital de Navarra
Centro Médico El Carmen

Ourense
Hospital de Galdakao
Complexo Hospitalario Universitario de Vigo
Hospital POVISA

Basque Country
Álava
Hospital Txagorritxu
Policlínica Guipúzcoa
Vizcaya
Hospital de Basurto
Hospital de Cruces
Hospital de Galdakao
Clínica V. San Sebastián

Public hospitals and state-subsidized private hospitals are in bold.