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The results of the Registry of the Working Group on Cardiac Catheterization and Interventional Cardiology of the Spanish Society of Cardiology for 2002 are presented. Data were obtained from 101 centers representing all cardiac catheterization laboratories in Spain; 95 centers performed mainly adult catheterization and 6 carried out only pediatric procedures.

In 2002, 97,609 diagnostic catheterization procedures were performed, including 83,667 coronary angiograms, representing a total increase of 5.1% in comparison to 2001. The population-adjusted rate was 2,053 coronary angiograms per 10^6 inhabitants.

Coronary interventions increased by 11% in comparison to 2001, with a total of 34,723 procedures and a rate of coronary interventions of 850 per 10^6 inhabitants. Coronary stents were the devices used most frequently, with 47,249 implanted in 2002, for a total increase of 20% in comparison to 2001. Stenting accounted for 91.7% of all procedures. Direct stenting was done in 13,768 procedures (43.2%). IIb-IIIa glycoprotein inhibitors were used in 9,966 procedures (28.7%). Multivessel percutaneous coronary interventions were performed in 9,830 patients (28%), and ad hoc interventions were done in the course of diagnostic coronary angiography in 26,341 patients (76%).

A total of 4,766 percutaneous coronary interventions were done in patients with acute myocardial infarction, representing an increase of 23.9% in comparison to 2001, and accounting for 13.7% of all interventional procedures.

Of the noncoronary interventions recorded, we note the decrease in percutaneous mitral valvuloplasties (21.2%) and atrial septal defect closures (11.1%), and the slight increase in pediatric interventions (3.7%).

In conclusion, we emphasize the high rate of reporting by laboratories, which allows the Registry to compile data that are highly representative of the activity at cardiac catheterization laboratories in Spain.

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

Full English text available at: www.revespcardiol.org
INTRODUCTION

Information is paramount in medicine, particularly in rapidly evolving specialties such as cardiovascular medicine. Data obtained from health registries can be used by health professionals and health authorities, as well as by other organizations involved in the prevention and treatment of disease and for better distribution of health care resources. We present the results of the Registry of the Working Group on Catheterization and Interventional Cardiology of the Spanish Society of Cardiology for 2002. This is the twelfth consecutive year that the Registry has published its report in the REVISTA ESPAÑOLA DE CARDIOLOGÍA.1-11 As before, the report includes data from almost all hospitals involved, both public and private. The data can therefore be considered representative of the work undertaken in this field in Spain.

METHODS

Registry data were collected from a questionnaire sent to all catheterization laboratories in Spain (Annex 1). The questionnaire had a few modifications compared to previous versions and could be completed on paper, on a computer file on disk or online via the web page of the Working Group. Izasa collaborated in the distribution and collection of the questionnaires and data analysis was done by the Directors of the Working Group.

RESULTS

Infrastructure and resources

A total of 101 centers participated in the Registry (Annex 2); 95 working with adult patients (12 of these also treating children) and 6 treating children only.

Adult hospitals

The 95 adult centers had a total of 129 hemodynamic laboratories, of which 119 (92%) were digital. This represents 2.27 centers and 3.08 laboratories per million inhabitants. Two or more hemodynamic laboratories were available in 29 centers and 86% of the centers had some sort of automated coronary quantification system. Thirty six centers (38%) were private and the other 59 (62%) belonged to the national health service.

Diagnostic and interventional procedures were undertaken by 98% of the hospitals and 2% undertook diagnostic procedures only. Cardiac surgery was performed in 78% (74/95). Coronary interventions were undertaken in 19 hospitals which did not perform cardiac surgery. A 24 hour emergency team was available in 63% of the centers.

Regarding medical staff, there were 273 doctors (2.8 per center; range, 1-7), a similar figure to 2001, with 6.52 specialists per million inhabitants. This figure is lower than the European mean in 1995 of eight specialists per million inhabitants.12 There were 315 nurse technicians and 98 radiological technicians, with a mean of 4.3 per center (range, 1-15).

Pediatric hospitals

The 6 exclusively pediatric hospitals had 7 laboratories (all digital). They all undertook interventional procedures and 5 (83%) had a 24 hour emergency team on call. The staff were made up of 12 doctors (2 per center; range, 1-3) and 10 nurse or radiological technicians (1.6 per center; range, 1-3).

Diagnostic activity

A total of 97 609 diagnostic catheterization procedures were undertaken in Spain in 2002, an increase of 2.3% compared to 2001;11 83 667 of these were coronary angiograms, an increase of 5.1%. The population-adjusted rate was 2053 coronary angiograms per million inhabitants. Figure 1 shows the distribution of the diagnostic catheterization procedures over the last 10 years. Apart from the increase in coronary angiograms, there was a notable decrease in the number of diagnostic procedures in patients with valve disease (13%). The radial approach was used in 5148 procedures (6.2%), an increase of 312% compared to 2001. Percutaneous vessel closure devices (including both diagnostic and therapeutic procedures) were used in 14 357 cases (an increase of 53.8% compared to 2001), of which 8512 (59.2%) were with collagen and 5625 (39.2%) with suture.

A total of 34 centers (35.7%) surpassed the rate of 1000 coronary angiograms per year and 6 of these (6.3%) undertook more than 2000 coronary angiograms per year. However, 35 centers (36.8%) did not reach 500 coronary angiograms per year (Figure 2). This gives a rate of 880 coronary angiograms per operator per year was 306,
higher than that for most countries for 1997. Of note is the fact that whereas private centers performed 394 coronary angiograms per center, public centers had a mean of 1177 coronary angiograms per center.

The growth rate in diagnostic procedures is tending to decrease in Spain. This has also been seen in other developed countries in Western Europe, where data for 1999 even showed a decrease in such countries as Switzerland or Austria, though their rates per million inhabitants were originally much higher than those for Spain. The number of coronary angiograms per million inhabitants varied greatly among the different autonomous regions in Spain (Figure 3).

Among intracoronary diagnostic procedures, intracoronary ultrasound and intracoronary pressure guidewire showed slight increases, though much lower than the differences for 2001 compared with 2000. There were 1712 intracoronary ultrasound procedures, an increase of 3.4% in comparison with 2001, and 1362 intracoronary pressure guidewire procedures, an increase of 2.2% compared to 2001. Intracoronary Doppler guidewire was used in 100 cases.

**Coronary interventions**

Coronary interventions increased by 11% compared to 2002, with a total of 34,723 percutaneous coronary interventions (PCI), representing 850 PCI per million inhabitants (Figure 4). This figure is higher than that of the latest European Registry, published in 1999 (714 angioplasties per million inhabitants) but lower than that already existing in 1999 in the leading countries for PCI, which were Germany, Iceland, France, Switzerland, Austria, Norway, Belgium and Luxembourg, in that order, and all of which surpassed the figure of 1000 PCI per million inhabitants in 1999.

The mean number of interventions per center was 373, with 273 per laboratory and 127 per operator. The mean numbers of PCI were 154 per private center and 505 per public center. The European mean was 429 PCI per center in 1999.

The percentage of PCI per coronary angiogram was 41% in 2002 versus 39% in 2001; this percentage is higher than the European mean for 1999 (28%). At least one restenotic lesion was addressed during the intervention in 6.9% of cases. Multivessel PCI was performed in 9830 cases (28%) and ad hoc interventions were carried out during the diagnostic coronary angiographic procedure in 26,341 cases (76%); the European mean for ad hoc procedures in 1999 was 48%. The radial approach for PCI was used in 2214 cases (6.4%). There were 1039 PCI in grafts, 84.8% with saphenous veins and 15.2% with mammary arteries, and 493 PCI were undertaken in the common trunk of the left coronary artery, which was protected in 30% of cases and unprotected in 70%.
Figure 5 shows the number of PCI per center. Despite the increased number of total procedures, 36.8% of all centers undertook fewer than 200 interventions per year and 60% fewer than 400. Figure 6 shows the number of PCI per million inhabitants in the different autonomous regions in Spain; the differences reflect those already observed for diagnostic procedures.

Glycoprotein IIb-IIIa inhibitors were used as coadjuvant therapy in 9966 procedures, an increase over 2001 in both absolute terms (42%) and relative figures (28.7% of procedures vs 22.4% in 2001). Intra-aortic counterpulsation balloon was used in 706 cases and percutaneous extracorporeal circulation in eight cases.

Overall results of coronary interventions were similar to previous years, with a success rate of 94.7%, a non-complicated failure rate of 3.1% and a 2.2% failure rate with complications: 1% mortality, 1.1% acute myocardial infarction and 0.1% requiring emergency surgery.

Interventions in acute myocardial infarctions

A total of 4766 PCI were done in patients with acute myocardial infarction, representing an increase of 23.9% in comparison to 2001, and accounting for 13.7% of all interventional procedures (Figure 7). Of these, 59.2% were primary PCI (59.2% in 2001), 30% rescue (28.7% in 2001) and 10.8% facilitated (Figure...
The 2821 primary PCI represented a 22.8% increase over 2001, and was thus greater than the percent increase in overall PCI, though this number still remains low in relation with the estimated number of acute myocardial infarctions per year in Spain. A total of 85 centers performed interventional procedures in patients with acute myocardial infarction. Of these, 14 did more than 100 PCI during the acute phase of the myocardial infarction, with most (59%) doing fewer than 50 PCI during the acute phase (Figure 9). Figure 10 shows the number of PCI done in patients with acute myocardial infarction per million inhabitants. A total of 605 PCI were undertaken during cardiogenic shock, which represents 12.7% of all cases of acute myocardial infarction.

**Stents**

Stents were the most commonly used devices in coronary interventions. A stent was used in 31,871 procedures, i.e. 91.7% of all interventions. The ratio of stents per procedure was 1.48 and the overall number of stents implanted was 47,249, of which 1906 (4.1%)
were drug-eluting stents. Direct stenting, with no balloon predilatation, was done in 13,768 stent procedures, representing 43.2% of all cases. Table 1 shows the number of stents implanted over recent years.

Other percutaneous interventional devices

Directional atherectomy was performed in 19 procedures in 4 centers, a marked decrease (83.3%) compared to 2001, and rotational atherectomy was done in 426 cases in 27 centers, a reduction of 4.2% in comparison with 2001 (Table 2). Notable among the other PCI was the increased use of a cutting balloon, used in 638 cases (an increase of 51%), thrombotic material extraction devices, used in 499 procedures (an increase of 51.6%), and distal embolization protection devices, used in 200 cases (four times the number in 2001). Septal branch alcoholization was undertaken in 15 cases and embolization of fistulas in nine cases.

Finally, there was a marked 14.2% increase in brachytherapy using the beta system during 2002, from 105 cases in 2001 to 120 cases in 2002, with 98 restenotic lesions and 22 de novo lesions. The intervention was successful in 118 lesions and there were 2 cases of non-fatal myocardial infarction.

Non-coronary interventions in adults

During 2002 a total of 397 adult valvuloplasties were undertaken in 41 centers, a decrease of 17% compared to 2001. This decrease was mainly explained by the 21.2% decrease in the number of mitral valvuloplasties, from 452 to 356 (Figure 11). The remaining non-coronary interventions were 17 aortic valvuloplasties and 24 pulmonary valvuloplasties.

Percutaneous devices were used to close atrial septal defects in 143 cases, an 11.1% reduction compared with 2001. Interventions were successful in 90.9% of cases, failed with no complications in 6.9% and with complications in 2.2% of cases. A further 50 procedures were performed in adult patients with congenital heart disease.

TABLE 1. Coronary stents from 1996-2002

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<td>70</td>
<td>80</td>
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<td>7104</td>
<td>14,497</td>
<td>17,783</td>
<td>22,580</td>
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<td>Units implanted, n</td>
<td>8873</td>
<td>14,170</td>
<td>19,378</td>
<td>22,946</td>
<td>29,504</td>
<td>39,356</td>
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<td>Stents per procedure, n</td>
<td>1.26</td>
<td>1.24</td>
<td>1.34</td>
<td>1.3</td>
<td>1.3</td>
<td>1.43</td>
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<td>Cases with stents per total PCI, %</td>
<td>27.6</td>
<td>47.3</td>
<td>61.5</td>
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<td>Direct stent, n</td>
<td>8778</td>
<td>11,280</td>
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<td>Direct stent, %</td>
<td>38.9</td>
<td>40.9</td>
<td>43.2</td>
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Interventions in pediatric patients

A total of 978 interventional procedures were done in children in 21 centers, an increase of 3.7% compared to 2001. These included 337 dilatations, 118 atrial septal defect closures and 171 ductal closures. Figure 12 shows the most frequent procedures.

CONCLUSIONS

One of the most important missions of the Working Group on Catheterization and Interventional Cardiology of the Spanish Society of Cardiology is to provide cardiologists with the annual data regarding their activity in Spain. Awareness of these data by health professionals, health authorities and the general public may result in better approaches to cardiovascular disease and in improved distribution of health care resources.

Diagnostic activity was increased in patients with ischemic heart disease, especially activity related with therapy, with the greatest percent increase in PCI in patients with acute myocardial infarctions. Great variation was noted, however, between the different autonomous regions of Spain regarding the number of diagnostic and therapeutic procedures.

TABLE 2. Rotational atherectomies (RA) and directional atherectomies (DA) from 1995-2002

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<td>Procedures</td>
<td>186</td>
<td>96</td>
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<td>Centers</td>
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<td>12</td>
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<td>4</td>
<td>9</td>
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Fig. 11. Historical evolution of number of mitral valve procedures since 1990.

Fig. 12. Distribution of pediatric interventions.

Dilatations: 337
Stents: 101
Septostomies: 128
Ductal closures: 175
Septal defect closure: 118
Embolizations: 30
Others: 89
Multivessel PCI was undertaken in 28% of all procedures and 91.7% of procedures involved placement of a stent, with direct implantation in 43.2% of cases. Both the ratio of PCI to coronary angiograms and the percentage of ad hoc PCI are among the highest in Europe.

Although the number of atherectomies fell, there was a notable increase in the use of thrombotic material extraction devices and distal embolization protection devices. Glycoprotein IIb-IIIa inhibitors were used in 28.7% of cases.

The number of PCI in patients with acute myocardial infarction rose by 23.9% compared to 2001, with a 22.8% increase in primary PCI.

Finally, the number of mitral valvuloplasties and percutaneous closures of atrial septal defects fell. Interventional activity in pediatric patients rose by 3.7%.

REFERENCES

ANNEX 1. Questionnaire for the report of the Working Group on Cardiac Catheterization and Interventional Cardiology - 2002

1. DEMOGRAPHIC DATA
   Hospital: .................................................................................................................................
   Address: .................................................................................................................................
   Zip code: .................................................................................................................................
   Province: .................................................................................................................................
   Telephone: ..............................................................................................................................
   Fax: .........................................................................................................................................
   E-mail: .................................................................................................................................
   Extension: ...............................................................................................................................
   Contacting doctor (responsible for the data): ........................................................................

2. LABORATORY DATA
   Number of laboratories:
     Conventional: ......................................................................................................................
     Digital: ...................................................................................................................................
   Number of staff doctors: ...........................................................................................................
   Number of staff doctors who do PCI: ......................................................................................
   Number of nurse technicians: ...................................................................................................
   Number of radiological technicians: .......................................................................................
   24 hour emergency service: ....................................................................................................
   YES: NO:
   Cardiovascular surgery available at the center: .....................................................................
   YES: NO:
   Activity database available:

3. DIAGNOSTIC ACTIVITY
   Total number of diagnostic procedures: ..................................................................................
     Number of coronary angiograms: ............................................................................................
     Number of studies in patients with valve disease: ..............................................................
     Number of endomyocardial biopsies: ....................................................................................
     Number of adults with congenital disease: ...........................................................................
     Number of pediatric patients: ..............................................................................................
     Other: .....................................................................................................................................
   Number of procedures with radial approach:
   A single diagnostic procedure is considered to be the combination of right and left cardiac catheterization whether or not accompanied by a coronary angiogram. A complete study in a patient with valve disease who also has a coronary angiogram is a study in a patient with valve disease. An isolated 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 one single procedure and should be counted as a biopsy so as not to interfere with the number of percutaneous coronary interventions (PCI)

4. OTHER DIAGNOSTIC STUDIES
   Quantitative coronary angiogram: ...........................................................................................
   YES: NO:
   Number of studies with echocardiography: ..........................................................................
   Number of studies with pressure guidewire: ...........................................................................
   Number of studies with Doppler guidewire: ..........................................................................
   The intracoronary studies are not to be counted separately within the full number of procedures. For example, a diagnostic coronary angiogram accompanied by a pressure guidewire study is one single procedure; a PCI with IVUS is one single procedure.

5. CORONARY INTERVENTION ACTIVITY
   Total number of procedures: * ..............................................................................................
   Number of multivessel procedures: .......................................................................................
   Number of procedures during the same diagnostic session: ................................................
   Number of restenosis procedures: ** ....................................................................................
   Number of saphenous vein procedures: ................................................................................
   Number of mammary artery procedures: .............................................................................
   Number of trunk procedures: ..............................................................................................
     Protected: ............................................................................................................................
     Unprotected: ......................................................................................................................
   Number of procedures with balloon only: ...........................................................................
   Number of procedures with radial approach: .......................................................................
   Number of procedures with anti-IIb-IIIa: ................................................................................
     Aciximab: ..............................................................................................................................
     Eptifibatide: ..........................................................................................................................
     Tirofiban: ..............................................................................................................................
   Number of procedures with ionic contrast: ...........................................................................
   Number of procedures with non-ionic contrast: ....................................................................

(Continue next page)
RESULTS.
Total number of successful procedures: ..................................................
Total number of failed procedures without complications:.......................
Total number of procedures with important complications:.....................
   Non-fatal AMI:
      Emergency surgery (24 hours): ....................................................
      Hospital death: ............................................................................
   *A coronary therapeutic procedure is considered to be attempted treatment of one or more coronary lesions, provided an attempt is made at
   introducing a guide wire in a coronary artery. However many devices are used in the same procedure (stent, IVUS, atherectomy, etc.) it is to be
   counted as just one procedure. **At least one of the lesions treated in a session is restenotic.

6. SUPPORT METHODS FOR INTERVENTIONAL PROCEDURES
Number of procedures with intra-aortic counterpulsation balloon: ............
Number of procedures with percutaneous extracorporeal circulation: .........

7. INTERVENTIONAL ACTIVITY IN ACUTE MYOCARDIAL INFARCTION
Total number of procedures related with AMI*: ....................................
   Primary PCI: .....................................................................................
   Rescue PCI:* ..................................................................................
   Facilitated PCI:** ............................................................................
Results:
   Successful without complications: .....................................................
   Important complications: .................................................................
   Emergency surgery: ........................................................................
   Hospital death: .............................................................................
Number of cases in cardiogenic shock (during the first 24 hours post AMI):
Results:
   Successful without complications: .....................................................
   Important complications: .................................................................
   Emergency surgery: ........................................................................
   Death: ...........................................................................................
Number of procedures with a stent: ......................................................
Number of procedures with a balloon only: .........................................
Number of procedures with anti-IIb-IIIa: .............................................
Number of procedures with thrombus extraction devices: ......................
Number of procedures with distal embolization protection: ...................
   *Rescue PCI: after failed thrombolytic therapy during the first 24 hours post AMI.
   **Facilitated PCI: elective after thrombolytic therapy (with or without anti-IIb/IIIa) during the first 24 hours post AMI.

8. CORONARY STENT
Total number of procedures: ...............................................................
Total number of stents implanted: .......................................................  
Total number of procedures without predilatation:* ............................
Number of drug-eluting stents: ...........................................................
   *All lesions in one session treated without predilatation.

9. OTHER DEVICES/PROCEDURES:
Total number of procedures: ...............................................................  
Directional atherectomy: .................................................................
Rotational atherectomy: .....................................................................
Other types of atherectomy: .............................................................
Coronary laser: ...................................................................................
Laser guidewire: ...............................................................................  
Transmyocardial laser: .....................................................................
Radiofrequency balloon: ..................................................................
Ultrasound therapy: .........................................................................
Cutting balloon: ...............................................................................  
Thrombotic material extraction devices: ...........................................
Distal embolization protection devices: ..............................................
(Continuation)

Percutaneous closure devices:
- With collagen:
- With suture:
- Others:
- Septal branch ablation:
- Embolization of fistulas:

10. BRAQUITERAPY
Total number of procedures:
- Beta:
- Gamma:
Total number of lesions:
- De novo:
- Restenotic:
Initial results:
- Total number of successful procedures:
- Total number of important complications:
  - Death:
  - Non-fatal AMI:
  - Surgery:

11. INTERVENTIONS IN ADULT PATIENTS WITH VALVE DISEASE
Percutaneous mitral commissurotomy:
Total number of procedures:
Result:
- Successful:
- Complications:
  - Cardiac blockade:
  - Severe mitral insufficiency:
  - Stroke:
  - Death:
Aortic valvuloplasty:
Total number of procedures:
Results:
- Successful:
- Complications:
  - Severe mitral insufficiency:
  - Stroke:
  - Death:
Pulmonary valvuloplasty:
Total number of procedures:
Results:
- Successful:
- Complications:
  - Cardiac blockade:
  - Death:

12. PROCEDURES IN ADULT PATIENTS WITH CONGENITAL DISEASE
Atrial septal defect closures:
Number of procedures:
- Successful:
- Failure without complications:
- Complications:
  - Death:
  - Others:
Aortic coarctation:
Other procedures in adults with congenital diseases (specify):
13. THERAPEUTIC PROCEDURES IN PEDIATRIC PATIENTS

Dilatations:
- Pulmonary valve:
- Aortic valve:
- Aortic coarctation:
- Subaortic stenosis:
- Pulmonary branches:
- Other dilatations:

Stents implanted in:
- Pulmonary artery branches:
- Aortic coarctation:
- Ductus:
- Other sites:

Atrial septostomy in:
- ICU:
- Catheterization laboratory:
- Ductus closure:
- Atrial septal defect closures:
- Embolizations:
- Others:

14. OBSERVATIONS AND COMMENTS:

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# ANNEX 2. Report of the Working Group on Cardiac Catheterization and Interventional Cardiology. Participating Laboratories in 2002

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CENTERS WITH DIFFERENTIATED PEDIATRIC ACTIVITY

| Barcelona        |                                   |
| Hospital Sant Joan de Déu |                               |
| Madrid            |                                   |
| Hospital La Paz   |                                   |
| Hospital Ramón y Cajal |                               |
| Malaga            |                                   |
| Hospital Maternomontal, Complejo Carlos Haya |                        |
| Seville           |                                   |
| Hospital Virgen del Rocio |                               |
| Valencia          |                                   |
| Hospital Universitario La Fe |                             |

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