

Journal für **Kardiologie**

Austrian Journal of Cardiology

Österreichische Zeitschrift für Herz-Kreislauserkrankungen

The European Registry of Cardiac Catheter Interventions 1998

Maier W, Meier B, Rotter M

Togni M, Windecker S, Zeiher A

Journal für Kardiologie - Austrian

Journal of Cardiology 2004; 11

(4), 145-148

Homepage:

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P.b.b. 02Z031105M,

Verlagsort: 3003 Gablitz, Linzerstraße 177A/21

Preis: EUR 10,-

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The European Registry of Cardiac Catheter Interventions 1998

W. Maier, A. Zeiher, M. Rotter, M. Togni, S. Windecker, B. Meier
on behalf of the Working Group Coronary Circulation of the European Society of Cardiology

Abstract: *Objective:* The tradition of yearly reports on cardiac catheter interventions in Europe has been initiated in 1992. This seventh report presents aggregated data on cardiac catheter procedures in 29 European countries performed in the year 1998.

Design and Setting: A detailed questionnaire addressing summary data of all cardiac interventions was mailed to presidents or designated delegates of the national societies of cardiology in Europe. The questionnaire was distributed to all institutions with cardiac catheterisation programs. All questionnaires were compiled in a national summary data sheet, then entered into a central data base and subsequently analysed. Main outcome measures: Coronary angiography, PTCA, and stenting in absolute numbers and per million inhabitants in the participating countries and the whole of Europe.

Results: Overall, 1,413,206 coronary angiograms were reported. The population-adjusted rate of coronary angiograms amounted to a mean of 2,554 per 10⁶ inhabitants. All in all there was no change compared with 1997. A total of 421,473 PTCA procedures were reported. The mean European number of PTCAs per 10⁶ inhabitants increased by 4 % from 733 in 1997 to 762 in 1998. From 1997 to 1998, procedures with stenting increased by 9 % from 235,637 to 260,315. The stenting rate, calculated as the sum of all stenting pro-

cedures related to all interventions was 62 %, compared with 58 % in 1997.

Conclusions: The major finding was that growth of coronary interventions in Europe seems to have reached some plateau. The forthcoming years will show if this slowing down reflects only a temporary observation or a saturation of the epidemiological demand.

Kurzfassung: Das Europäische Register kardialer Katheterinterventionen im Jahr 1998. *Zielsetzung:* Die Tradition jährlicher Reporte über die kardialen Katheterinterventionen in Europa wurde 1992 begründet. Dieser siebte Report legt die zusammengefaßten Daten diagnostischer und therapeutischer Herzkathetereingriffe aus 29 Ländern Europas für das Jahr 1998 in der Perspektive der vorausgegangenen Reporte vor.

Methoden: Ein detaillierter Fragebogen bezüglich aller kardialen Katheterinterventionen wurde an alle Präsidenten der nationalen kardiologischen Fachgesellschaften, alternativ an die Vorsitzenden der invasiven bzw. interventionellen Arbeitsgruppen oder an von den Fachgesellschaften beauftragte Repräsentanten versandt. Von dort wurden die Fragebögen an alle Institutionen mit Herzkatheterlabors verteilt. Die ausgefüllten Fragebögen wurden zunächst in einem nationalen Datenblatt regional zusammengefaßt und danach in

eine zentrale Datenbank eingegeben und analysiert. Zentrale Ergebnisparameter sind die absolute sowie die auf die Einwohnerzahl bezogene Anzahl von Koronarangiographien, PTCAs und Stentimplantationen in den einzelnen Ländern und in Europa insgesamt.

Ergebnisse: Insgesamt wurden 1.413.206 Koronarangiographien dokumentiert, bezogen auf die Bevölkerungszahl aller eingeschlossenen Länder im Mittel 2554 pro Million Einwohner. Damit ergab sich keine relevante Veränderung im Vergleich zu 1997. Gesamthaft wurden 421.473 PTCAs gemeldet, entsprechend 762 pro Million Einwohner, was einer Zunahme von 4 % im Vergleich zum Jahr davor (733 pro Million Einwohner) entspricht. Interventionen mit Stentimplantation nahmen um 9 % von 235.637 auf 260.315 zu. Entsprechend betrug die Stentrategie, definiert als Summe aller Interventionen mit Stenting bezogen auf die Summe aller Interventionen, 62 % im Vergleich zu 58 % im Jahr davor.

Zusammenfassung: Insgesamt scheint das stetige Wachstum der diagnostischen und therapeutischen Herzkathetereingriffe, wie es in den vergangenen Jahren beobachtet wurde, ein gewisses Plateau erreicht zu haben. Die kommenden Jahre werden zeigen, ob es sich hierbei nur um ein temporäres Phänomen handelt oder ob eine Sättigung des von der Epidemiologie der Herzerkrankungen vorgegebenen Bedarfs erreicht ist. **J Kardiologie 2004; 11: 145–8.**

■ Introduction

The report on the 1998 activity of interventional cardiology continues the tradition of yearly reports initiated in 1992 [1–6]. As in the previous years, it aims at presenting an overall picture of interventional cardiology in Europe by the means of aggregated data collected by the voluntary effort of a specific task force with the endorsement of the Working Group Interventional Cardiology and Coronary Pathophysiology of the European Society of Cardiology.

■ Methods

Set-Up of the Registry

A detailed questionnaire, adapted to current trends in the field, with instructions and examples is being mailed every year to the presidents or designated delegates of the national societies of cardiology represented in the European Society of Cardiology. They distribute a copy of the questionnaire to all institutions, performing diagnostic or interventional procedures in their respective countries. All questionnaires are compiled in a national summary data sheet. This task lies in the hands of the national representatives. The summary data sheets are entered

into a central data base and subsequently analysed. In 1998, no data were received from Cyprus and Ireland as in the previous years. Data quality was poor from Hungary, Norway, Poland, and the Netherlands. The Dutch representative provided but the plain number of percutaneous coronary interventions. Data had to be detailed from other sources [7]. As in the preceding report [6], a group of 29 countries representing more than 550 million people in Europe are covered by this survey. The definitions of diseases and procedures were used according to the previous reports [4].

Limitations of the Registry

In registry data, sources of potential error include limited external validation of the raw data provided by the local institutions, different local depths of documentation, and communication errors between the institutions, national coordinators, and the central data base. Elementary data on coronary angiography, coronary angioplasty (PTCA), and stenting are supplied readily. Although today virtually every catheterisation laboratory uses computerised performance statistics, procedural details supplied on national and on supranational level are deficient. Therefore, those data must be considered as approximate. However, the involvement of the national societies of cardiology, either directly or by designated delegates, ensures conformity with national registries and statistics and thus guarantees the best level of accuracy to be achieved with current methodology. Overall, the data provide an important overview of interventional cardiology (electrophysiology excluded).

Eingelangt am 16. Dezember 2003; angenommen am 26. Dezember 2003.

Swiss Cardiovascular Center Bern, University Hospital, Bern

Correspondence to: Bernhard Meier, MD, Professor and Chairman, Swiss Cardiovascular Center Bern, University Hospital, CH-3010 Bern, Switzerland, E-Mail: bernhard.meier@insel.ch

In Germany – the key contributor to this registry – the data were gathered in 1998 for the first time through a different task force nominated by the national working group. The German figures in 1998 were about of 5–20 % lower than 1997. This is likely due to both a decreasing trend induced by budget restrictions, and a difference in data collection.

■ Results

The major procedures (coronary angiography, PTCA, stenting, new devices, coronary ultrasound) are listed in table 1 in absolute numbers and numbers per 10⁶ inhabitants. For reference, the changes from 1997 are also depicted.

Coronary Angiography

Overall, 1,413,206 coronary angiograms were reported during 1998. The population-adjusted rate of coronary angiograms amounted to a mean of 2,554 per 10⁶ inhabitants for all of Europe during 1998 (ranging from as high as 6,233 in Germany to as low as 173 in Romania). Population-adjusted there was no change compared with 1997, the absolute numbers differ due to different reporting levels. The highest absolute number was reported from Germany with 510,510 and the lowest from Iceland with 1,172 coronary angiograms. In contrast to the previous years a decreasing trend was observed in a few countries (e.g. Germany –6 %, Greece –7 %). As in the preceding years, the highest relative growth was observed in eastern European countries, mostly in those countries with the biggest backlog (e.g. Croatia +78 %, Latvia +49 %, Lithuania +29 %, Romania +23 %), whereas the growth in the more advanced eastern countries continued at a nearly constant rate of about 20 % (e.g. Czechia +23 %, Poland +20 %). The average, calculated by averaging the country means, was $2,207 \pm 1,464$ angiograms per 10⁶ inhabitants (mean \pm standard deviation). More than 3,000 coronary angiograms per 10⁶ inhabitants were reported in decreasing order from Germany, Belgium, Iceland, Austria, Switzerland, France, Luxemburg and Norway, whereas less than 500 coronary angiograms per 10⁶ inhabitants were observed in decreasing order in the two countries Bulgaria and Romania as in 1997.

Coronary Angioplasty

A total of 421,473 PTCA procedures were reported in Europe during 1998, a 4 % increase from 1997. Compared with the increase of 24 % from 1996 to 1997, this indicates a slower pace of growth in interventional procedures, even considering changes in data collection in Germany. The mean European number of PTCA per 10⁶ inhabitants increased by 4 % from 733 in 1997 to 762 in 1998. The average, calculated by averaging the country means, was 649 ± 509 PTCA per 10⁶ inhabitants. As in 1997, the highest absolute and population adjusted number of PTCA were reported from Germany with 153,257 procedures (1,871 per 10⁶ inhabitants). They represented, however, a 9 % decrease from 1997. The lowest absolute number of PTCA was observed in Luxemburg, a nation of 0.42 million people with 369 cases and the lowest number of PTCA per 10⁶ inhabitants again in Romania (24). In parallel with the figures for coronary angiography, eastern coun-

tries showed also the steepest increase in coronary interventions: Croatia +211 %, Lithuania +67 %, Slovakia +58 %, Hungary +55 %, Estonia +42 %, Latvia +41 %. Considerable augmentations were still reported for Denmark (+37 %) and Italy (+36 %), whereas in Germany a slight decrease was observed. In France the increase was only moderate (9 %). More than 1,000 PTCA per 10⁶ inhabitants were reported in decreasing order from Germany, Iceland, Belgium, Switzerland, France, and Austria, whereas fewer than 100 PTCA per 10⁶ inhabitants were observed in decreasing order only in Bulgaria and Romania. Croatia and Slovakia have left this category in 1998.

The ratio of PTCA per coronary angiography showed a slightly increasing tendency: in Europe as a whole: 30 % in 1998 versus 29 % in 1997, and 27 % (1997: 24 %) when averaging the country means. The ratio of PTCA to coronary angiograms ranged from 39 % in Iceland to 14 % in Romania.

The percentage of percutaneous interventions performed at the time of the diagnostic study may be considered either as an indicator of cost efficiency, but it may also be influenced by organizational policies. Data were available for 36 % of the total population. These data confirm that *ad hoc* PTCA is more or less established in some countries and still cautiously practised in others, resulting in a considerable per country variation. The mean percentage of *ad hoc* PTCA, calculated as sum of all *ad hoc* PTCA reported per sum of interventions for the countries reporting, was 40 % (1997: 43 %). The highest rates were reported from Luxemburg (81 %) and Switzerland (77 %).

Data on multivessel PTCA were available for 43 % of the population. The mean incidence of multivessel PTCA, calculated as sum of all reported multivessel PTCA divided by the sum of interventions for the countries reporting this variable, was 12 %, which is slightly lower than in the preceding year with 14 %.

Coronary Stenting

From 1997 to 1998, reported procedures with stenting increased by 9 % from 235,637 to 260,315. The overall stenting rate, calculated as the sum of all reported stenting procedures related to all reported interventions was 62 %, compared with 58 % in 1997. This indicates in 1998 a plateau in the prior exponential growth curve. Germany performed the highest absolute number of stent procedures (73,776), followed by France (60,261). Greece turned out to be the country with the highest stenting rate (100 %, even reporting 2 % more stent than PTCA cases) and thus has overtaken France. The stenting ratio was > 50 % in the majority of countries, except for (in decreasing and alphabetical order): Germany, Slovenia, Finland, Estonia, Slovakia, Bulgaria, Hungary, Lithuania (table 1).

Other New Devices

The use of other new therapeutic devices, such as laser angioplasty, directional coronary atherectomy, rotablation, or ultrasound therapy was available for 76 % of the survey population. A total of 6,290 cases were reported which means in absolute terms a reduction of roughly 40 % compared with the reported overall numbers of the previous year, even when considering the differences in population samples. Accordingly,

1998

Table 1: European Registry of Cardiac Interventions: Selected Country Data (na = not available)

	Austria	Belgium	Bulgaria	Croatia	Czechia	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Iceland	Italy	Latvia	Lithuania	Luxembourg	Netherlands	Norway	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	Switzerland	Turkey	UK
Population to serve (million inhabitants)	8.1	10.2	8.4	4.8	10.3	5.3	1.5	5.1	58.4	81.9	10.5	10.2	0.3	57.4	2.5	3.7	0.4	15.5	4.4	38.6	9.9	22.6	5.3	2.0	39.3	8.8	7.1	62.0	58.8
Coronary angiography (n)	34,419	48,313	3,661	5,009	22,894	11,410	2,000	12,039	209,243	510,510	19,007	10,163	1,172	124,837	1,723	4,421	1,318	41,004	14,168	34,101	16,295	3,919	4,690	2,108	59,321	21,164	27,994	82,278	84,025
Δ 97/98 (%)	19	5	28	78	23	13	20	1	5	-6	-7	5	12	21	49	29	2	na	4	20	17	23	28	10	2	-15	7	15	na
Coronary angiography per million population (n)	4,249	4,737	436	1,044	2,223	2,153	1,379	2,361	3,583	6,233	1,810	996	4,341	2,175	689	1,195	3,295	2,642	3,220	883	1,646	173	885	1,054	1,509	2,405	3,943	1,327	1,429
PTCA (n)	8,559	15,154	595	1,171	6,558	3,871	445	2,524	75,744	153,257	3,774	2,007	453	36,269	465	1,210	369	15,237	4,677	7,208	3,687	552	734	582	20,146	6,641	9,561	15,124	24,899
Δ 97/98 (%)	13	12	17	211	25	37	42	13	9	-9	-25	55	21	36	41	67	-4	2	16	-2	22	38	58	23	9	9	8	20	9
PTCA per million population (n)	1,057	1,486	71	244	637	730	307	495	1,297	1,871	359	197	1,678	632	186	327	923	982	1,063	187	372	24	138	291	513	755	1,347	244	423
Stent (n)	5,838	7,622	211	1,217	4,490	3,079	181	1,082	60,261	73,776	3,834	704	274	25,756	280	158	257	9,467	3,508	3,638	2,658	393	273	259	14,497	4,735	6,446	8,241	17,180
Δ 97/98 (%)	33	94	50	443	28	55	242	58	19	-22	18	81	25	55	241	90	2	26	26	59	36	264	113	-9	27	15	26	51	25
Stent/PTCA (%)	68	50	35	100	68	80	41	43	80	48	102	35	60	71	60	13	70	62	75	50	72	71	37	45	72	71	67	54	69
Sum new devices (n)	304	85	0	0	32	164	0	40	1,127	3,001	65	na	9	na	na	na	5	na	na	na	94	16	0	7	668	201	79	144	249
Sum ultrasound + Doppler (n)	543	379	0	4	40	850	0	62	773	3,313	386	na	0	na	24	na	0	na	na	na	82	na	0	0	1,168	na	234	221	469
PTCA per angiography (%)	25	31	16	23	29	34	22	21	36	30	20	20	39	29	27	27	28	37	33	21	23	14	16	28	34	31	34	18	30
Multivessel PTCA per PTCA (%)	11	23	25	40	17	25	8	22	na	9	24	na	22	na	14	13	8	na	na	na	18	29	9	10	17	na	15	na	na

the ratio of new devices to all coronary interventions was further reduced (1.5 % in 1998 versus 2.5 % in 1997).

Intracoronary ultrasound (6,904) and Doppler flow measurements (1,644) decreased in relation to the preceding year 1997 in absolute reported figures. The ratio of reported intracoronary ultrasound and Doppler flow measurements per intervention with specified ultrasound data fell from 5.6 % to 2.5 %, indicating a clear decline in contrast to the increase in the previous year.

Noncoronary Interventions

Balloon valvuloplasty constituted the most frequent noncoronary intervention reported in 1998 with a total of 2,659 mitral valvuloplasties (1997: 2,630), 108 aortic valvuloplasties (1997: 249), and 532 pulmonary valvuloplasties (1997: 457). Other percutaneous interventions included of 381 cases with closure of a patent ductus arteriosus (1997: 395), 235 closures of a patent foramen ovale (1997: 136), 449 closures of an atrial septal defect (1997: 205).

Complications

Data on procedure-related major adverse cardiac events, i.e. infarction, emergency coronary artery bypass grafting (CABG), and death were available for a sample size of 39 % of the whole population. However, the two countries with the highest absolute interventional volume, Germany and France, were not able to give these figures. The respective ratios are infarction 1.2 %, emergency CABG 0.4 %, and death 0.7 %.

Discussion

This seventh European registry of coronary interventions, as its predecessors, is intended to give a rough and global picture of interventional activity per country with aggregated, not individual patient data. Detailed procedural data collection on a per patient basis as for example in the United States the American College of Cardiology – National Cardiovascular Data Registry [8], the Society for Cardiac Angiography and Interventions Registry [9], and the dynamic National Heart, Lung and Blood Institute registries [10] pursue different goals. These registries share with our survey the limited external validation in comparison with sponsored, randomized, multicenter trial data, but to some extent analyse individual patients' courses. The goal of our survey in its present form is to collect the anonymous, global procedure statistics of cardiac catheter interventions. Providing of this kind of data should be more or less compulsory nowadays for national reports. Nevertheless, redundant data collection is cumbersome and time consuming both on national and supranational levels even for the elementary data sets. This explains that the data are still exclusive, but, however, systematically delayed for about 3 years. Conclusions can be drawn primarily for trends in procedures per inhabitants, for comparisons of resource allocation per country, and for comparisons with epidemiological indicators [11]. The epidemiological background is planned

to be extended by implementation of already existing regional data in Europe.

The year 1998 showed, compared with the previous years, a slowing down of the growth rates of coronary angiographies and interventions, amounting in the previous years to globally between 10 and 20 per cent per year. This might be primarily related to budget restrictions in the most active western European countries Germany and France, and the Benelux group, in which the increase for most of the procedures did not exceed ten per cent. As for other western/central European countries, Spain, Switzerland, and the UK remained also below 10 per cent of growth compared with 1997, whereas Austria, Italy and Portugal showed increases of more than 10 %. It is of particular interest that Portugal, coming from a comparably low level of coronary intervention rates as the UK, shows double digits increments, whereas the UK does not. In 1998, Czechia, a country belonging to the former Eastern bloc until 1989, was performing over 50 % more coronary angioplasties per million inhabitants than the UK. Since the initiation of this registry, the UK interventional activity has been dimensionally inferior to the western continental countries, resulting e.g. in 1998 in a more than 4 times lower population-adjusted intervention rate compared to Germany.

The observation of a temporary levelling off of the increase in percutaneous revascularisation in the more active countries of continental Europe goes in parallel with a stagnation of coronary artery bypass surgery (CABG). Gosh and Unger [7] reported only a 2 % increase in CABG from 1997 to 1998, calculated on a per million inhabitants basis for Europe as a whole and based on a registry comprising a comparable population of 516 million people. Local registries in central European countries with a high revascularisation activity even hint at a declining tendency for CABG.

The most active countries worldwide in terms of coronary revascularisation are undisputedly the United States. However, the fact that official registry or survey data on coronary revascularisation on a national basis are still missing prevents a comparison. The only available source, the annual statistical update of the American Heart Association, based on estimates, demonstrates in its most recent edition [12] a still increasing trend for the year 1998 with a levelling off in 1999, whereas CABG already decreases in 1998. Thus, a certain degree of saturation seems to be achieved in both Europe and the US. However, any prognosis on the future development of coronary revascularisation based on these observations remains speculative.

The use of stents per intervention also seems to have reached some plateau at a percentage of around 60 %, which may reflect good clinical judgement for the given spectrum of lesions and lesion locations with the technology of 1998.

The rates of PTCA per angiography and multivessel PTCA remained rather stable almost since the initiation of this registry, indicating no major change of paradigm during this period. Nevertheless, considerable variations between countries exist. The stability regarding PTCA per angiography could be interpreted as a consistency in indications for diagnostic catheterization over the years, which also means that the threshold for angiography has not been lowered despite an overall increase of volume. More striking is the stability in multivessel PTCA given the dramatic extension of the interventional armaments with at least stents and IIb/IIIa antagonists [13].

In summary, the major finding of the 1998 survey is that, overall, the increment of coronary interventions in Europe seems to have reached some plateau, with continued need to catch up in eastern European countries, in which growth is still exponential. Only a few eastern countries cannot participate in this development, presumably due to their unresolved economic backlog. An incomprehensible dimensional discrepancy in numbers of interventions per population persists between the UK and the rest of the developed western continental European countries. The forthcoming years will show if the slowing down in growth of coronary interventions in Europe reflects only a temporary observation or a definitive saturation of the epidemiological demand.

■ Acknowledgement

We are indebted to all representatives of the national societies of cardiology participating in this survey. Furthermore, we acknowledge the tremendous effort of all individual centers in collecting the surveyed data and completing the questionnaires. The principal data coordinators of each individual country participating in this survey are in alphabetical order:

Austria: Mühlberger V. **Belgium:** Heyndrickx G. **Bulgaria:** Finkov B. **Croatia:** Mihatov S. **Czech Republic:** Vojacek J. **Denmark:** Thayssen P. **Estonia:** Peeba M. **Finland:** Ropponen L. (Suomen Sydänilitto ry) **France:** Lablanche J. M. **Germany:** Mannebach H., Horstkotte D. **Greece:** Voudris V. **Hungary:** Duba J. **Iceland:** Eyjolfsson K. **Italy:** Piscione F. **Latvia:** Kalnins U. **Lithuania:** Navickas R. **Luxembourg:** Beissel J. **The Netherlands:** de Boer M. J. **Norway:** Vik-Mo H. **Poland:** Ruzyllo W. **Portugal:** Palos J. L. **Romania:** Fotiade B. **Slovak Republic:** Fridrich V. **Slovenia:** Cijan A. **Spain:** Soriano J. **Sweden:** Albertson P. **Switzerland:** Meier B. **Turkey:** Özmen F. **United Kingdom:** De Belder M.

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