

Micha Maeder, Jean-Christoph Stauffer,
Stephan Windecker, Franz Eberli,
Giovanni Pedrazzini, André Vuillomenet,
Hans Rickli; on behalf of the Working Group
“Interventional Cardiology and Acute
Coronary Syndrome”

Interventional cardiology in Switzerland 2004

Summary

Background: Since 1987, a nationwide annual survey of percutaneous cardiac interventions is performed in Switzerland, which allows recognition of contemporary trends and comparison with other countries.

Methods: Based on a standardised questionnaire, all adult percutaneous cardiac intervention centres in Switzerland were asked to report on the volume and the circumstances of their activities in 2004. The response rate was 100%. Data were compared with those from previous years.

Results: In 2004, 35 201 coronary angiographies (CA; 2003: 33 066; + 6.5%) and 15 680 percutaneous coronary interventions (PCI; 2003: 14 235; + 10.2%) were carried out in 5 university hospitals, 9 public, non-university hospitals, and 12 private hospitals by 194 operators (75 of them performing only diagnostic studies). 86% of PCI were performed *ad hoc*, and 80% were single-vessel interventions. Stents were placed in 91% of PCI (2003: 88%). In 60% of stenting procedures one stent was implanted, whereas in 40% two or more stents were placed. Drug-eluting stents (DES) were used in 66% of procedures (2003: 52%). PCI for ongoing myocardial infarction, ie primary PCI or rescue PCI after failed thrombolysis, accounted for 20% of interventions. Glycoprotein IIb/IIIa inhibitors were used in 23% of PCI, the variability among different centres being high. Myocardial infarction after PCI was reported in 1.4% of PCI, emergency coronary artery bypass grafting was needed in 0.1% of cases, and in-hospital mortality after PCI was 0.5%.

In addition to PCI, 40 mitral, 21 aortic, and 7 pulmonary balloon valvuloplasties, and 438 interventions for closure of patent foramen ovale as well as 92 interventions for closure of atrial septal defect were performed.

Conclusions: The number of CA and PCI, the frequency of stent placement during PCI, and the utilisation of DES are steadily increasing in Switzerland. There is also a significantly growing number of interventions for closure of

patent foramen ovale and atrial septal defect, whereas the number of balloon valvuloplasties has been more or less stable over the last years.

Key words: coronary angiography; angioplasty; stents; balloon valvuloplasty; shunts; quality control

Zusammenfassung

Hintergrund: Seit 1987 werden die perkutanen kardiologischen Eingriffe zur Erkennung aktueller Trends und für den internationalen Vergleich schweizweit erfasst.

Methoden: Basierend auf einem standardisierten Fragebogen wurden alle Zentren, die bei Erwachsenen perkutane kardiologische Eingriffe durchführen, über Umfang und Details ihrer interventionellen Aktivitäten im Jahr 2004 befragt. Die Rücklaufquote der Fragebögen betrug 100%. Die Daten wurden mit denjenigen früherer Jahre verglichen.

Ergebnisse: Im Jahr 2004 wurden in 5 Universitätsspitalern, 9 öffentlichen, nicht-universitären Zentren und 12 Privatkliniken 35 201 Koronarangiographien (CA; 2003: 33 066; +6,5%) und 15 680 perkutane koronare Interventionen (PCI; 2003: 14 235; +10,2%) durchgeführt, dies durch 194 Operateure, von denen 75 ausschliesslich diagnostische Eingriffe durchführten. 86% der PCI wurden *ad hoc* durchgeführt, und 80% waren Eingefäss-Eingriffe. Stents wurden bei 91% aller PCI implantiert (2003: 88%). Bei 60% der PCI mit Stenting wurde ein Stent implantiert,

Correspondence:
Hans Rickli, MD
Division of Cardiology
Department of Internal Medicine
Kantonsspital St. Gallen
Rorschacherstrasse 95
CH-9007 St. Gallen
Switzerland
E-Mail: hans.rickli@kssg.ch

No conflicts
of interest to declare.

während bei 40% der Eingriffe zwei oder mehr Stents verwendet wurden. Medikamentenbeschichtete Stents (drug-eluting stents [DES]) wurden bei 66% der PCI mit Stenting verwendet (2003: 52%). Primäre PCI im Rahmen eines akuten Myokardinfarkts oder Rescue-PCI nach Lyse-Versagen machten 20% der Eingriffe aus. Glykoprotein-IIb/IIIa-Hemmer wurden bei 23% der PCI eingesetzt, wobei sich grosse Unterschiede zwischen den verschiedenen Zentren zeigten. Myokardinfarkte nach PCI wurden auf 1,4% der Eingriffe beziffert, eine notfallmässige aortokoronare Bypass-Operation war in 0,1% der Fälle notwendig, und die Spitalmortalität nach PCI betrug 0,5%. Zusätzlich zu den PCI wurden 40 Mitralklappen-, 21 Aortenklappen- und 7 Pulmonalklappen-Valvuloplastien durchgeführt sowie 438 Eingriffe zum Verschluss eines offenen Foramen ovale und 91 Interventionen mit Verschluss eines Vorhofseptumdefekts.

Schlussfolgerungen: Die Zahl an CA und PCI, die Stent-Rate und die Verwendung von DES nehmen in der Schweiz stetig zu. Zudem wächst die Zahl der Eingriffe für den Verschluss von offenem Foramen ovale und Vorhofseptumdefekt, während die Zahl der Ballon-Valvuloplastien in den letzten Jahren stabil geblieben ist.

Schlüsselwörter: Koronarangiographie; Angioplastie; Stents; Ballon-Valvuloplastie; Shunts; Qualitätskontrolle

Introduction

Since 1987, an annual nationwide survey of interventional procedures in all cardiology centres in Switzerland is performed, which allows recognition of contemporary trends and analysis of implementation of study results and guidelines in daily practice [1–14]. The analysis also serves as an instrument of quality control, which is highly important for procedures being both expensive and invasive, such as in interventional cardiology. The recorded data will also be integrated in the annual survey of the European Society of Cardiology. In Switzerland, we have the opportunity to link the present data to those obtained from a prospectively conducted, nationwide registry of patients hospitalised for acute coronary syndrome, the Acute Myocardial Infarction in Switzerland Plus (AMIS Plus) registry.

The aim of the present study was to provide cardiologists but also other interested physicians with the most recent data on interventional cardiology activities in Switzerland, to integrate the data with those of the AMIS Plus registry, and to compare the Swiss practice with that suggested in the recently published European guidelines on percutaneous coronary intervention (PCI) [15].

Methods

Based on a questionnaire all cardiology centres performing interventional procedures in adult patients were asked to report on procedures done in 2004. The questionnaire was not sent to the two centres, whose activities are restricted to pediatric patients (Kinderspital Zürich, Kinderspital Bern). The required items included data about infrastructure, operators, availability of cardiac surgery, number of coronary angiographies (CA) and PCI, detailed information about circumstances of PCI (*ad hoc* interventions, single-vessel PCI, multi-vessel PCI), access site, management of puncture site, other revascularisation techniques (e.g. rotablator), adjunctive techniques (e.g. use of distal protection devices), use of mechanical circulatory support, use of glycoprotein IIb/IIIa inhibitors, number of peripheral and renal artery interventions, number of balloon valvuloplasties, number of interventions for closure of shunts, number of other interventions, and complications. As in previous years, the questionnaires were returned by all centres. For some centres, information is not available for all items. This will be indicated in the presentation of the data in the “results” section. The following definitions were applied:

Coronary angiography (CA)

Diagnostic cardiac catheterisation for visualisation of the coronary arteries, independently whether or not an intervention is performed in the same session. The number of cases is recorded.

Percutaneous coronary intervention (PCI)

Coronary angioplasty with or without stent placement. If PCI is performed directly following the diagnostic procedure during the same session, it is called “*ad hoc* PCI”. The number of cases, but not the number of vessels dilated is recorded. Interventions with stent placement were divided into single-stent and multi-stent procedures and into those employing bare-metal stents (BMS) and drug-eluting stents (DES).

PCI for ongoing infarction

Primary PCI or rescue PCI after failed thrombolysis.

Balloon valvuloplasty

Percutaneous dilatation of stenotic cardiac valves.

Not yet published data of the years 2002 and 2003 have been provided by Dr. Reho and Dr. Eberli, University Hospital Zürich. This is gratefully appreciated.

Results

Structure of Swiss centres

In 2004, there were 26 active centres (5 university hospitals, 9 public, non-university hospitals, 12 private hospitals), all performing both diagnostic procedures and percutaneous interventions. In contrast to previous years, the University Hospital Zürich (Universitäts-Spital Zürich; USZ) and the Kantonsspital Winterthur (KSW) were taken together as one centre. Among the 26 centres, 16 work with one cath lab, 8 centres have two catheterisation facilities (two cath labs at the university hospital of Basel are shared by the University Hospital and the Claraspital), and there is one centre with three labs (Geneva), and one centre has four labs (USZ/KSW). Seventy-five (2003: 47) operators perform only diagnostic studies, whereas 119 (2003: 106) cardiologists are doing both CA and PCI. In 20 centres, cardiac surgery is available in the same hospital, and 23 centres have an electronic database.

Percutaneous coronary interventions

In 2004, 35201 CA (2003: 33066; + 6.5%) and 15680 PCI (2003: 14235; + 10.2%) were carried out. The evolution of the annual numbers of CA and PCI since 1987 is presented in figure 1 and table 1. In figure 2, the distribution of all interventions among the different centres is shown, which corresponds more or less to the situation in previous years. The theoretical number of CA per operator during 2004 was 181 (2003: 216), and the average number of PCI per operator was 132 (2003: 134). However, the latter figures are critically influenced by the number of operators, which was much higher in 2004 than in 2003, especially for those performing only diagnostic studies. There are major differences between the average numbers of examinations per operator among different centres as shown in figure 3.

In 11433/13249 (86%; data not available from two centres) cases, PCI was performed *ad hoc* (2003: 83%). The majority of PCI were single-vessel interventions (11857/14795; 80%;

Figure 1

Evolution of coronary angiographies and percutaneous coronary interventions between 1987 and 2004.

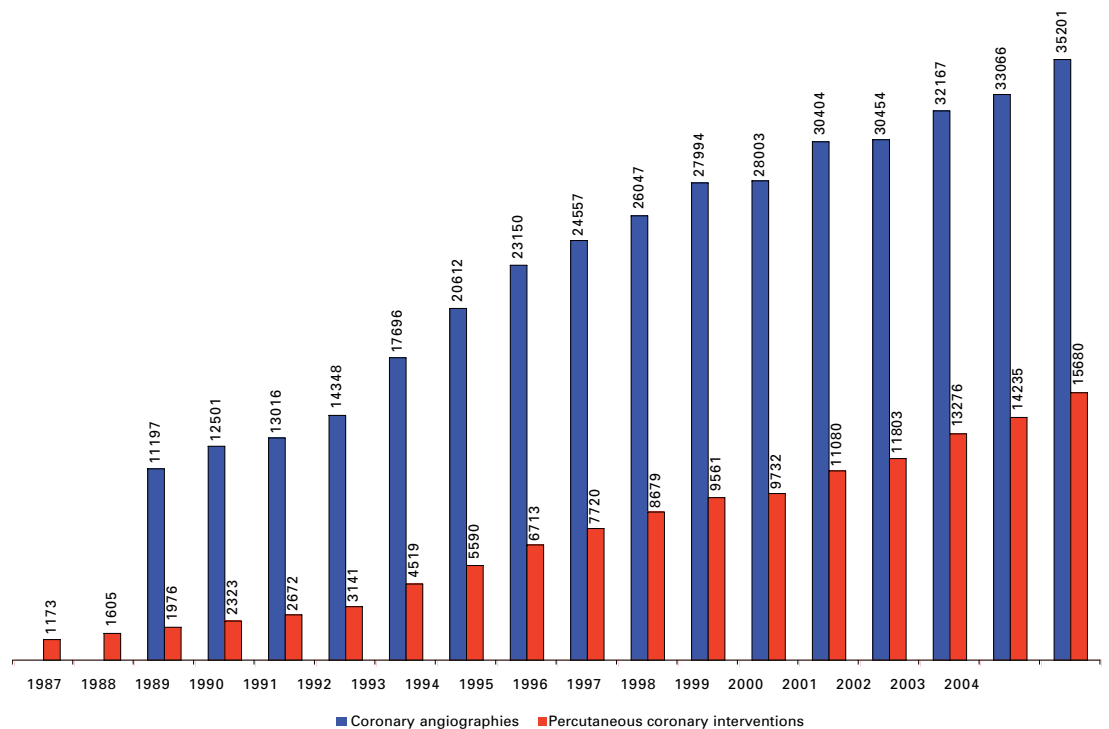
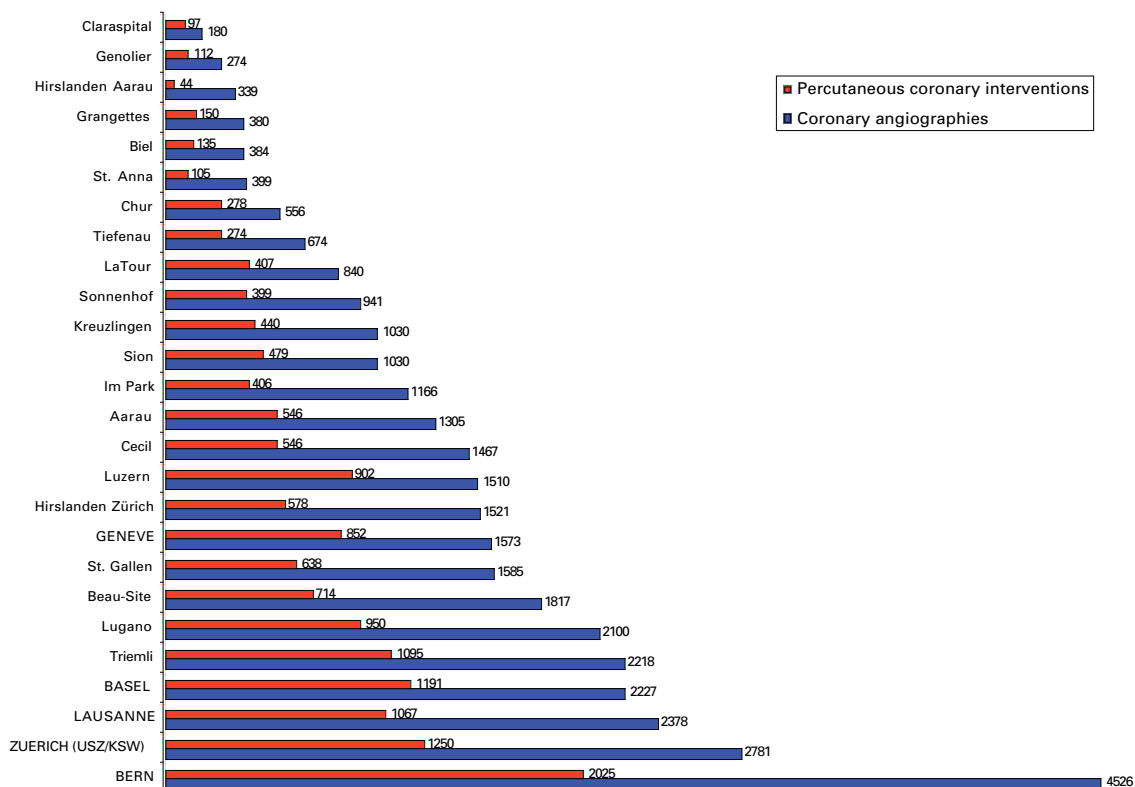


Table 1
Evolution of percutaneous cardiac interventions between 1987 and 2004.

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Coronary angiographies (n)			11197	12501	13016	14348	17696	20612	23150	24557	26047	27994	28003	30404	30454	32167	33066	35201
Percutaneous coronary interventions (n)	1173	1605	1976	2323	2672	3141	4519	5590	6713	7720	8679	9561	9732	11080	11803	13276	14235	15680
Ad hoc (%)						43	39	53	59	60	74	77	83	82	73	78	83	86
Multivessel (%)	29	20	13	13		11	10	10	11	12	14	15	13	14	13	17	19	20
Ongoing Infarction (%)			4		3	3	4	6	6	7	8	10	11	12	15	19	20	
Use of stents for PCI (%)			1		4	6	15	28	50	59	67	73	78	82	84	88	91	
Drug-eluting-stents (%)																16	52	66
Glycoprotein IIb/IIIa inhibitors (%)										3	7	14	17	19	22	23	21	23
PCI-induced myocardial infarction (%)		1.9	1.6		1.5	1.2	1.2	1.1	1.1	1.2	1.2	1.5	1.2	0.9	1.7	1.4	1.4	
Emergency CABG (%)			2.7	1.6		1.2	0.8	0.9	0.7	0.4	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1
In-hospital mortality (%)			0.6	0.9		1.0	0.6	0.6	0.6	0.7	0.6	0.6	0.9	0.6	0.5	0.5	0.7	0.5
Valvuloplasties (n)	34	43	40	39	71	71	86	53	59	56	75	53	68	82	56	56	55	68
Closure of shunts (n)			5	6	8	12	32	32	42	66	69	107	167	246	328	476	548	

PCI = percutaneous coronary intervention; CABG = coronary artery bypass grafting

Figure 2
Coronary angiographies and percutaneous coronary interventions in different centres. The centres are grouped according to their annual volume. USZ = UniversitätsSpital Zürich; KSW = Kantonsspital Winterthur



data not available from two centres; 2003: 81%), and in 2938/14 795 (20%; data not available from two centres; 2003: 19%) cases multi-vessel PCI was performed. The percentage of stents used for PCI has also increased as compared with previous years and is now at 91%

(2003: 88%). The evolution of the utilisation of stents from 1992 to 2004 is shown in figure 4. In 7509/12 523 (60%) of stenting procedures one single stent was placed, whereas in 5014/12 523 (40%) interventions two or more stents were implanted (data not available from

Figure 3

Coronary angiographies and percutaneous coronary interventions per operator in different centres (grouped according to the annual average volume per operator).
USZ = UniversitätsSpital Zürich;
KSW = Kantonsspital Winterthur

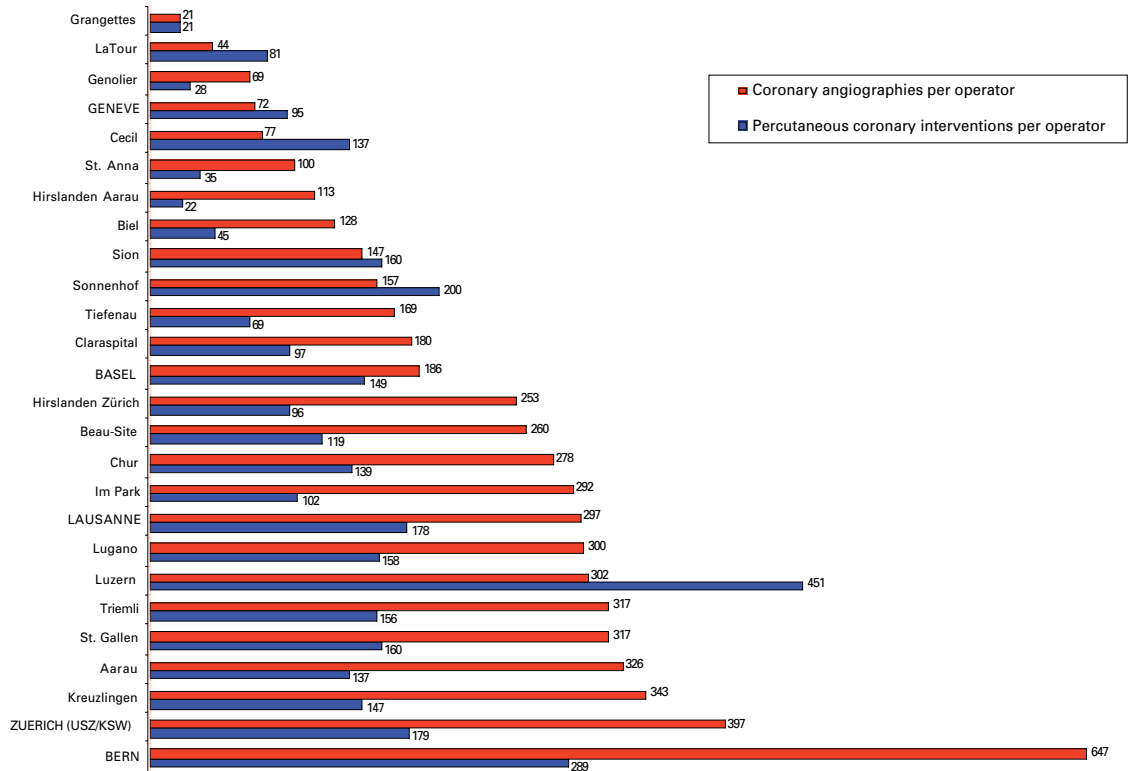
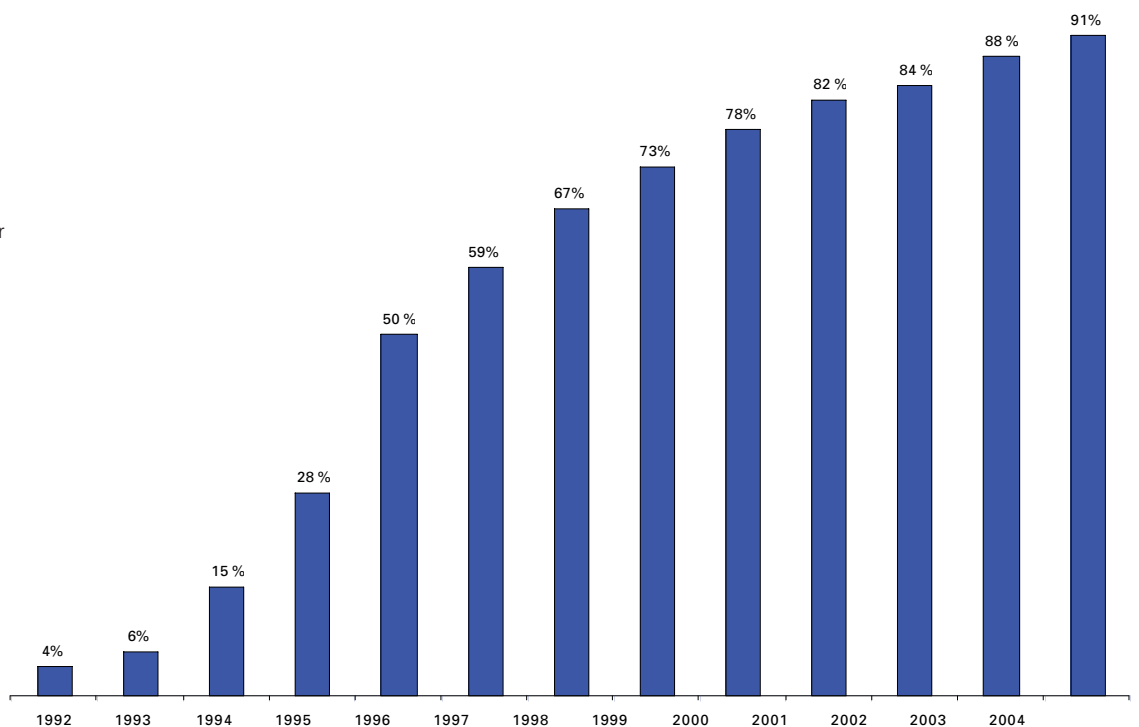


Figure 4

Evolution of the use of stents between 1992 and 2004. The bars represent the stent utilisation rates (percutaneous coronary interventions with stent placement/all percutaneous coronary interventions) over the years.



three centres). In 4605/13424 (34%; data not available from two centres) PCI with stent placement BMS were employed, and in 8819/13424 (66%; data not available from 2 centres) stenting procedures DES were used, corresponding to a higher utilisation of DES as

compared with previous years (2003: 52%). The percentage of DES employed for PCI varies considerably among different centres ranging from 23 to 100% as shown in figure 5.

PCI for ongoing myocardial infarction, ie primary PCI or rescue PCI after failed throm-

Figure 5

Drug-eluting stent utilisation rates (interventions with drug-eluting stent placement/all interventions with stent implantation) for percutaneous coronary interventions in different centres.

USZ = UniversitätsSpital Zürich;
KSW = Kantonsspital Winterthur

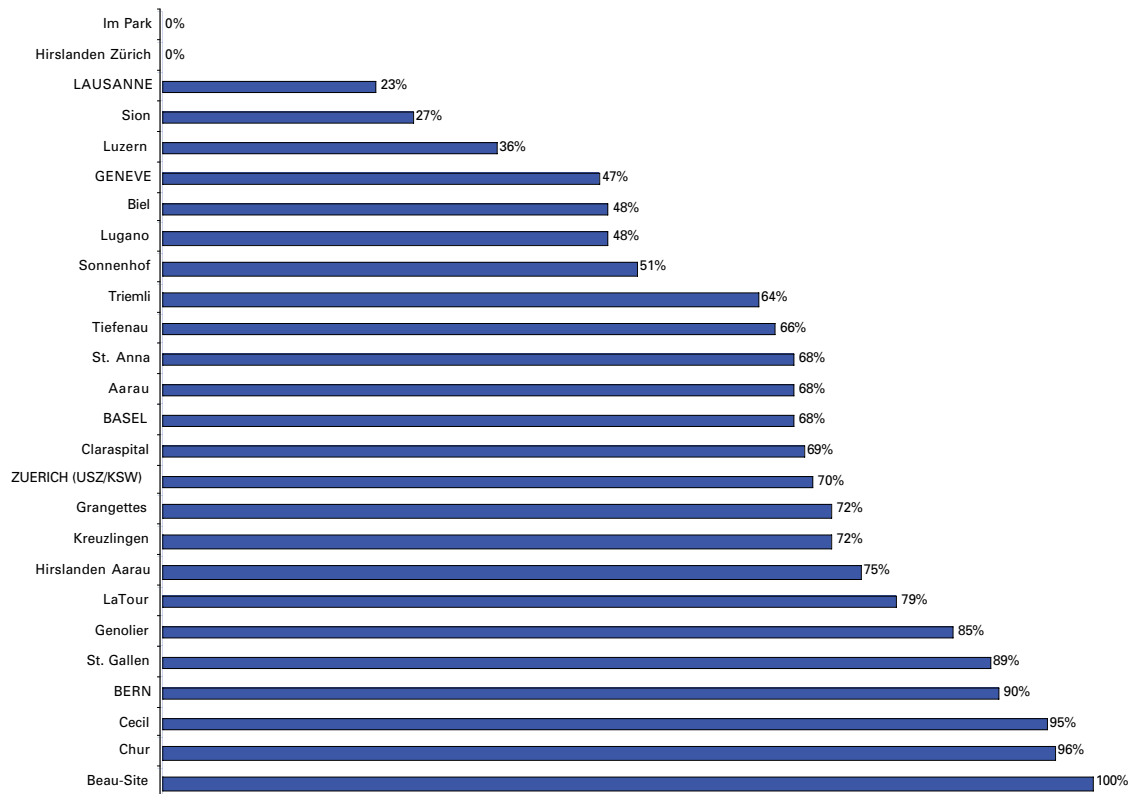
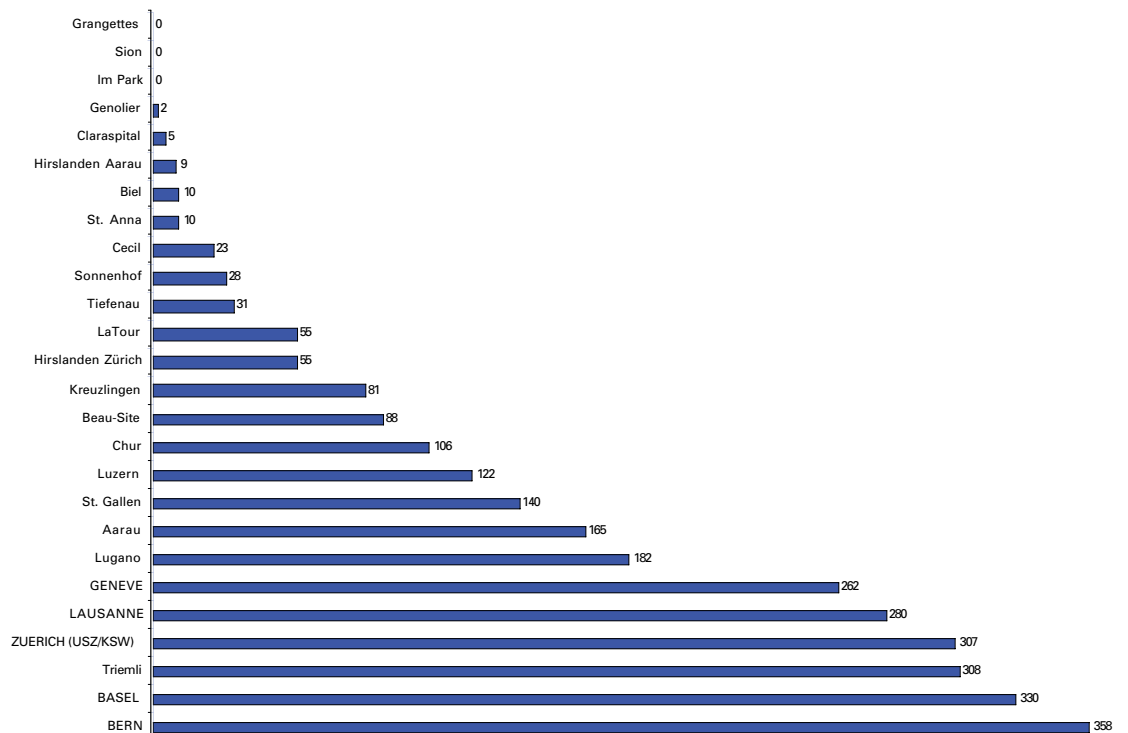


Figure 6

Absolute numbers of percutaneous coronary interventions for ongoing myocardial infarction in different centres.

USZ = UniversitätsSpital Zürich;
KSW = Kantonsspital Winterthur



bolysis, accounted for 2957/14 795 (20%; data not available from two centres; 2003: 19%) interventions. The number of PCI for ongoing infarction among the different centres is shown

in figure 6. PCI in cardiogenic shock was reported to be done in 160 cases. Glycoprotein IIb/IIIa inhibitors were used in 3601/15 680 (23%; data not available for two centres; 2003:

Figure 7

Use of glycoprotein IIb/IIIa inhibitors from 1996 to 2004. The glycoprotein IIb/IIIa inhibitor utilisation rates (percutaneous coronary interventions with glycoprotein IIb/IIIa inhibitors/all percutaneous coronary interventions) are given.

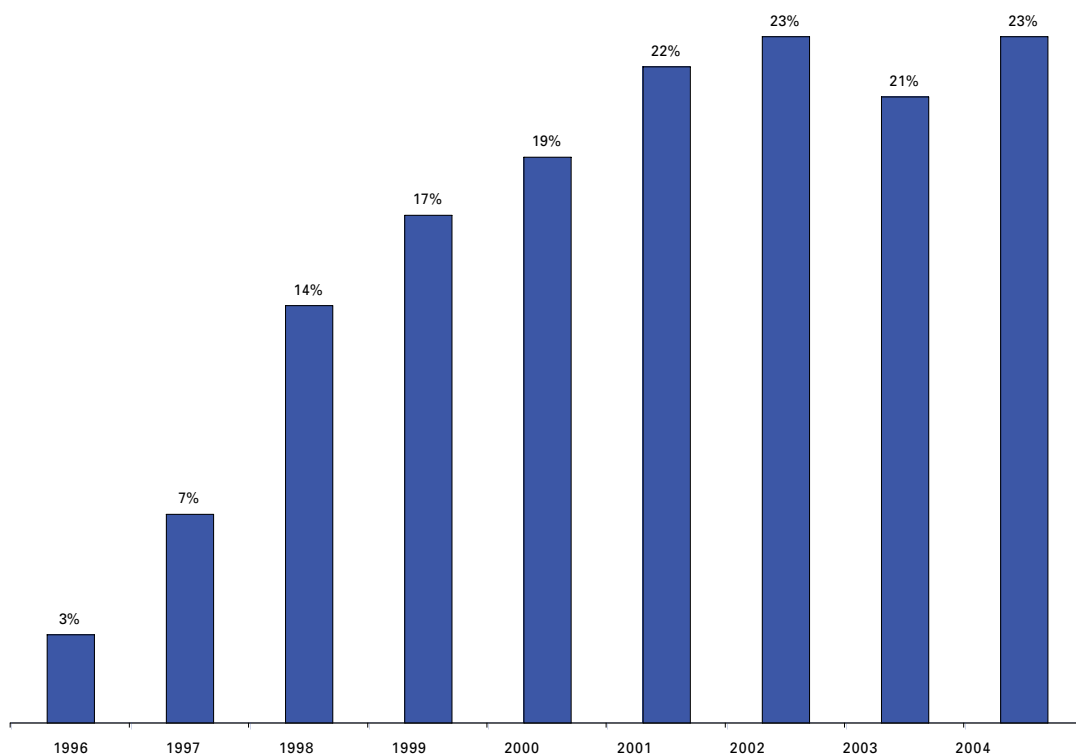
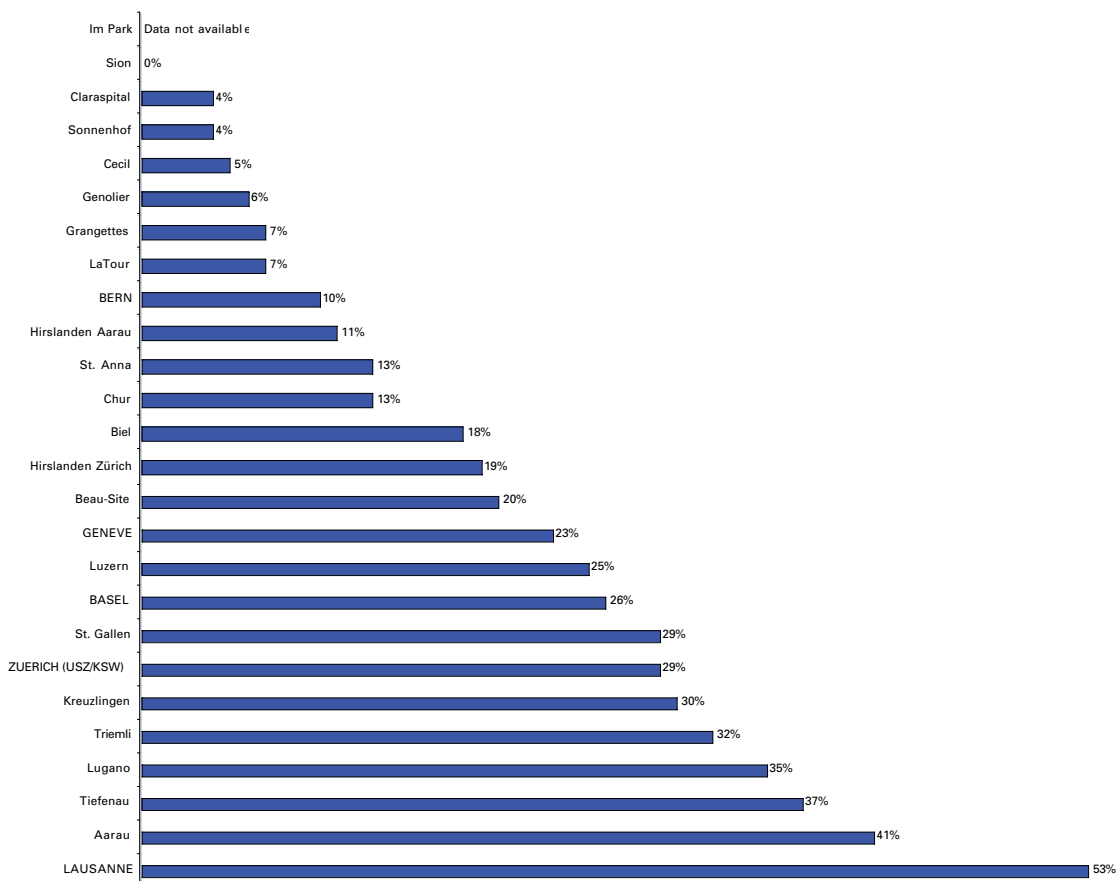


Figure 8

Glycoprotein IIb/IIIa inhibitor utilisation rates (percutaneous coronary interventions with glycoprotein IIb/IIIa inhibitors/all percutaneous coronary interventions) for percutaneous coronary interventions in different centres. USZ = UniversitätsSpital Zürich; KSW = Kantonsspital Winterthur



21%) PCIs. Over the last four years, the utilisation rate of glycoprotein IIb/IIIa inhibitors was stable at 20–25% (fig. 7). However, there are still considerable differences among the different centres with respect to the use of glycoprotein IIb/IIIa inhibitors (fig. 8).

In most studies, the femoral access was chosen. Only in 198 cases another access site (brachial, radial) was used. The analysis of the data on management of the arterial puncture

site was complicated by the fact that some centres reported data on all CA, whereas others gave data restricted to PCI. Notwithstanding, some trends can be recognised: manual compression is the most frequent method to close the arterial puncture site (60%) if all examinations including only diagnostic studies are considered. However, in the majority of PCI, collagen-based closure devices are employed (57%).

Figure 9
Complications following percutaneous coronary interventions between 1987 and 2004. Data for 1991 and 1992 are not available. AMI = acute myocardial infarction; CABG = coronary artery bypass grafting

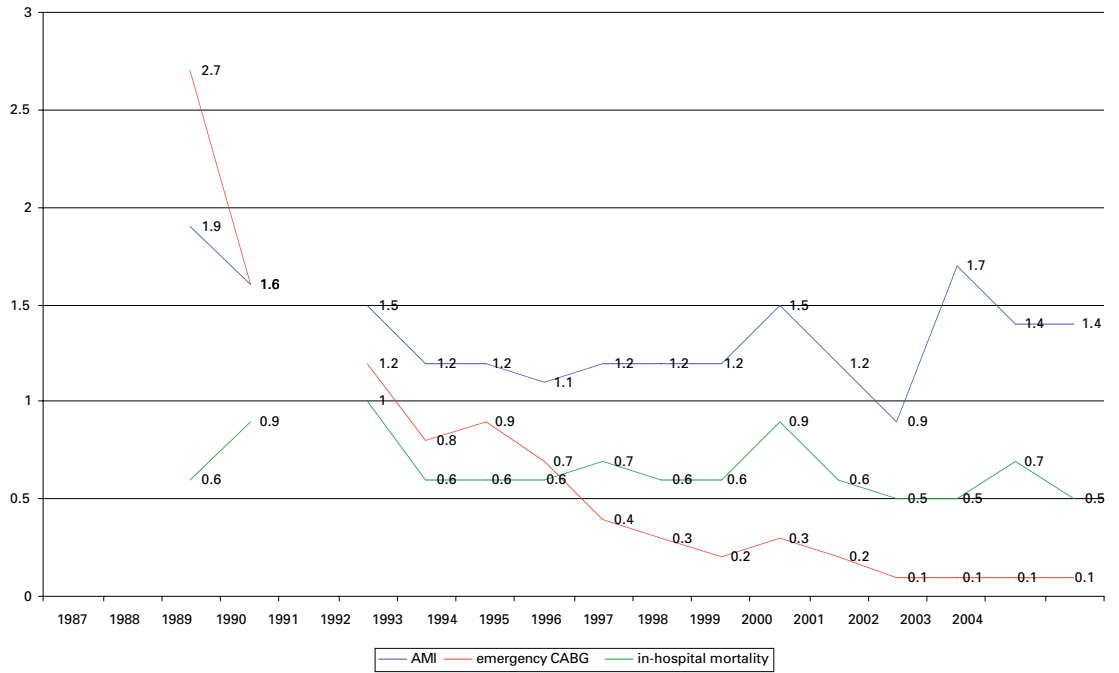


Figure 10
Balloon valvuloplasties from 1987 to 2004.

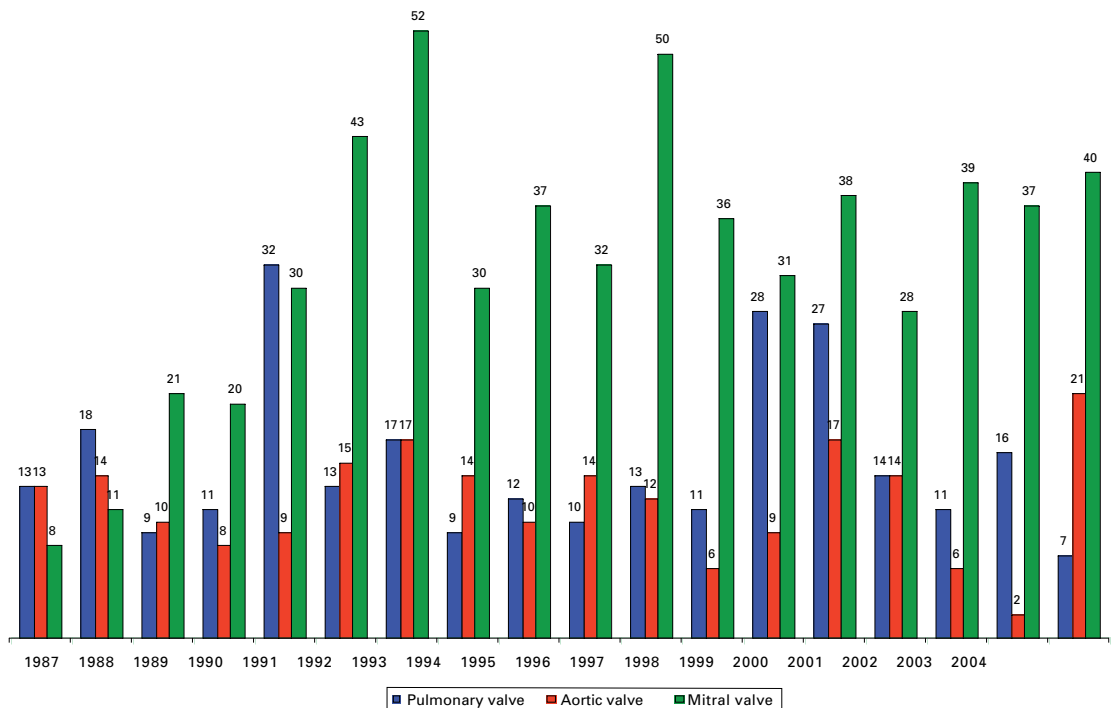


Figure 11

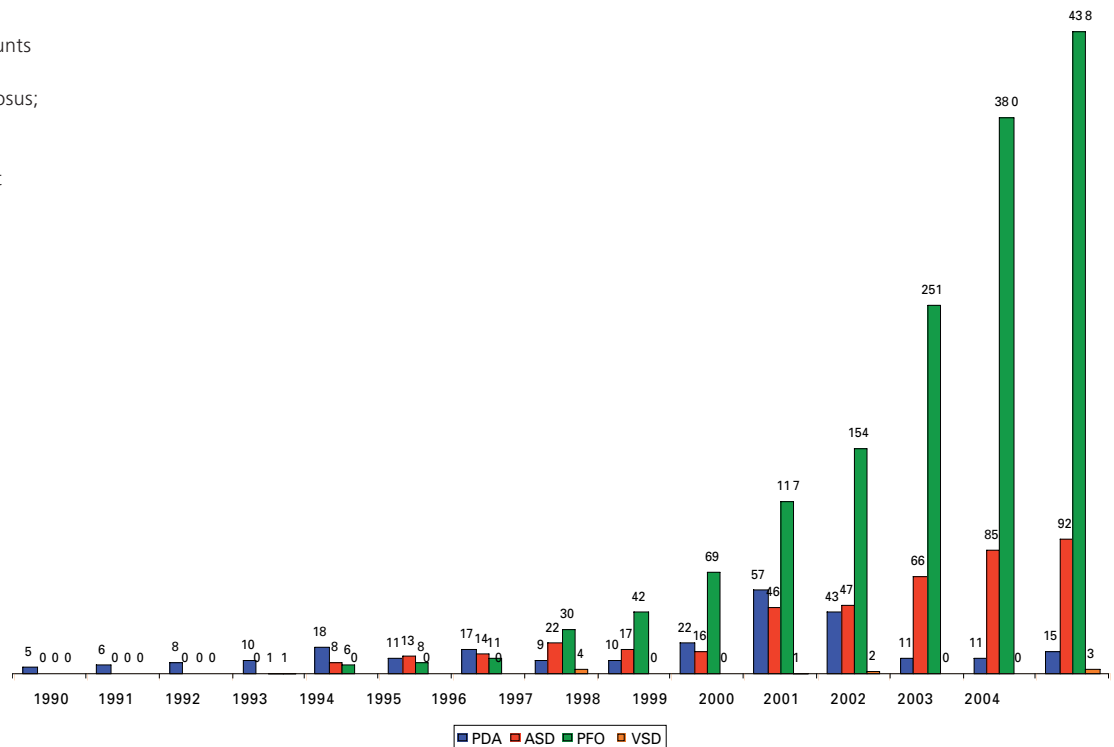
Interventions for closure of shunts from 1990 to 2004.

PDA = persistent ductus arteriosus;

ASD = atrial septal defect;

PFO = patent foramen ovale;

VSD = ventricular septal defect



Distal protection devices were used in 480 (3% of PCI; 2003: 714) cases, an intracoronary pressure wire was employed in 370 (2.4%; 2003: 315) cases, and 59 (0.4%; 2003: 129) intracoronary Doppler and 468 (3%; 2003: 417) intravascular ultrasound examinations were performed.

Revascularisation techniques other than balloon angioplasty including rotablator (40 cases; 2003: 46) and atherectomy (0 cases; 2003: 1) have very rarely been employed. Sonotherapy (2003: 14 patients) or laser wire recanalisation (2003: 3 patients) have not been done in any patient. The number of cases with application of intracoronary brachytherapy has decreased from 108 in 2003 to 35 cases in 2004. Mechanical circulatory support systems consisted of 332 (2003: 341) intraaortic balloon pumps and 10 (2003: 0) percutaneous left ventricular assist devices.

Complications after PCI

Myocardial infarction after PCI was reported in 215/15 680 (1.4%; 2003: 199/14 235; 1.4%) cases, emergency coronary artery bypass grafting (CABG) was performed in 15/15 680 (0.1%; 2003: 16/14 235; 0.1%) patients, and 86 (2003: 100) patients were reported to have died during the in-hospital period following PCI. Thus, the mortality rate after PCI is approximately 0.5% (2003: 0.7%). The reported rate of complications after PCI since 1987 is shown in figure 9.

Non-coronary interventions

In 2004, 40 mitral, 21 aortic, and 7 pulmonary balloon valvuloplasties were performed. The number of these interventions was more or less stable during the last years (fig. 10). In contrast, the number of procedures for closure of shunt is steadily increasing over the last years (fig. 11). In 2004, closure of patent foramen ovale was carried out in 438 cases (2003: 360), and interventions for atrial septal defect closure were performed in 92 patients (2003: 85).

Peripheral angioplasties are carried out by radiologists and angiologists in most hospitals. However, cardiologist reported 87 iliac or leg interventions (63% with stent placement), 61 carotid artery angioplasties (95% with stent implantation), and 108 renal artery interventions (74% with stent placement). In addition, alcohol ablation of septal hypertrophy was done in 34 patients. Other very rare interventions included 7 pulmonary embolectomies, 6 subclavian artery interventions, one endovascular therapy for aortic aneurysm, one angioplasty of a stenotic pulmonary artery graft, and one angioplasty after repair for anomalous pulmonary venous return.

Comparison between university, non-university public, and private hospitals

In table 2, there is a comparison of university hospitals, non-university-hospitals, and private hospitals with respect to infrastructure,

Table 2

Comparison between university hospitals, public, non-university hospitals, and private hospitals.

	University hospitals (n = 5)	Public non-university hospitals (n = 9)	Private hospitals (n = 12)
Cath labs (n)	13	11	15
Operators (n)	56	44	94
Operators performing both CAs and PCIs (n)	37	35	47
CAs (n)	13485	11362	10354
CAs per operator (n)	241	258	110
PCIs (n)	6385	5297	3998
PCIs per operator (n)	173	151	85
Ad hoc PCI (%)	90 ^a	91	76 ^c
Multivessel PCI (%)	23	15 ^b	21 ^c
PCI for ongoing infarction (%)	24	22 ^b	10 ^c
Stents (%)	90	93	91
Drug-eluting stents (%)	65	58	81 ^d
Glycoprotein IIb/IIIa inhibitors (%)	25	28	14 ^c
PCI complicated by myocardial infarction (%)	2.7 ^a	0.8	1.5 ^c
Urgent coronary artery bypass grafting after PCI (%)	0.1 ^a	0.02	0.2
In-hospital mortality (%)	1.1 ^a	0.4	0.4
Balloon valvuloplasties (n)	56	6	6
Closure of shunts (n)	362	86	100

CA = coronary angiography; PCI = percutaneous coronary intervention
^a data available from 4/5 centres; ^b data available from 8/9 centres; ^c data available from 11/12 centres;
^d data available from 10/12 centres.

procedures, and complications. When referring to the data from 2001 [13], most trends can be observed in all sectors, except for the pronounced increase in PCI for ongoing infarction at the university hospitals and the increase in interventions for closure of shunts in the public non-university hospitals.

Discussion

Despite the retrospective nature of this study with its inherent limitations, the present survey sufficiently reflects the daily practice in interventional cardiology among Swiss cardiologists in 2004. Based on the present data the following trends can be observed: the number of CA and PCI, the frequency of stent placement in PCI, and the use of DES are steadily increasing over the last years. There is also a significant increase in number of interventions for closure of patent foramen ovale and atrial septal defect, whereas the number of balloon valvuloplasties has been more or less stable over the last years.

Centres and operators

The number of operators performing both diagnostic studies and interventional procedures has increased more than the number of

examinations, leading to lower average numbers of examinations per operator. However, careful interpretation of these data is warranted, since in the questionnaire only numbers but not names of operators were provided, and the possibility of double counting of one single operator working in different hospitals, and thus a false low average number of examinations per operator cannot be excluded. In addition, the theoretical average number of examinations and even the average number of examinations in a given centre is not a meaningful parameter, as there might be a discrepancy between the number of examinations performed by fellows in training and the busiest operators. The fact that in some centres the average number of PCI is higher than the corresponding number for CA indicates that PCI are done by a smaller number of trained operators, of whom most very probably have an annual volume ≥ 75 procedures as suggested by the guidelines of the American College of Cardiology/American Heart Association [16].

Percutaneous coronary interventions

Based on the present data, a population adjusted PCI rate of approximately 2200 per million inhabitants can be calculated for 2004, which is very similar to the corresponding rate in Germany in 2000, the leading European

country with respect to the population-adjusted CA and PCI rates [17]. In between, Germany has reached a population-adjusted PCI rate of approximately 3000 per million inhabitants [18].

The further increase in the number of procedures in Switzerland is mainly due to an increase in elective procedures, as there were only 230 emergency PCI more than in 2003. The small increase in *ad hoc* PCI reflects the fact that all centres are doing both diagnostic studies and interventions now. The absolute and relative increase in multi-vessel PCI might be interpreted as a trend towards multi-vessel PCI as an alternative to surgery. With the availability of DES multivessel PCI has become an attractive and feasible option, and the trend observed in 2004 might continue. In addition, the increase might be due to a more aggressive treatment of angina also in elderly patients. The TIME study showed that revascularisation in patients >75 years with angina pectoris CCS class ≥ 2 despite two antianginal drugs was superior to optimal medical therapy in terms of symptom relief and quality of life [19].

There was a further increase in the percentage of interventions with stent placement. The steadily increasing use of DES is not surprising as studies have shown a dramatic benefit in terms of both angiographic (late lumen loss) [20] and clinical (target vessel revascularisation) [21] endpoints in the studied populations. There are only very few data on the use of DES in other countries. However, the already available DES utilisation rate of approximately 13% in Germany [18] indicates that the Swiss rate (66%) is exceptionally high. Interestingly, the use of DES varies considerably among different centres, which may be explained by differences in interpretations of indications, financial constraints, or other reasons. Of note, the current PCI guidelines of the European Society of Cardiology are very reluctant with respect to indications for DES by recommending them only for patients and lesions fitting the inclusion criteria of randomised trials [15]. A recently published study suggests that a sirolimus-eluting stent is superior to a paclitaxel-eluting stent with respect to clinical and angiographic measures of restenosis [22]. Interestingly, the use of DES in an "all-comers" setting is less cost effective than in studies with selected patients. DES have been shown to be more cost effective for elderly patients in specific high-risk groups [23].

Both the absolute and the relative number of emergency procedures done in 2004 were

higher than in 2003, which reflects the current trend towards a higher proportion of patients with ST-segment elevation myocardial infarction (STEMI) undergoing early reperfusion by PCI [24]. Current guidelines recommend primary PCI for patients with STEMI presenting within 12 hours after onset of chest pain or other symptoms, and rescue-PCI if thrombolysis has failed within 45–60 minutes, and for high-risk patients with non-ST-segment elevation myocardial infarction (NSTEMI) [15]. A recently published analysis from the AMIS Plus registry revealed that between 1997 and 2002 the percentage of patients with STEMI receiving no reperfusion has decreased from 44.8 to 31.4%, and that the percentage of patients undergoing primary PCI has increased from 8.0 to 43.1%, whereas the percentage of those treated by thrombolysis has decreased from 47.2 to 25.6% [24]. However, 75% of patients with STEMI are admitted to hospitals without cath labs and a 24 hours PCI service [25], and these patients less often receive reperfusion therapy as compared to those admitted to hospitals with a catheterisation facility, although several studies suggest that in patients with STEMI presenting 3–12 hours after onset of chest pain, transfer to a tertiary care centre for primary PCI is superior to thrombolysis with respect to salvage myocardium but also to prevent stroke [26].

The use of glycoprotein IIb/IIIa inhibitors did not significantly change as compared to the previous three years. In patients with NSTEMI glycoprotein IIb/IIIa inhibitors are recommended by guidelines [15], and a retrospective analysis from the AMIS Plus registry confirmed their usefulness in patients with NSTEMI in Switzerland [27].

Regarding the management of the puncture site, a clear trend towards more frequent use of closure devices after PCI can be observed. This method with consecutively earlier ambulation than after manual compression has been shown to be safe and cost-effective, and to be associated with less patient discomfort than manual compression [28].

Adjunctive techniques

Distal protection devices were used in approximately 3% of PCI, probably most often for interventions in saphenous vein grafts, where the benefit is proven [29] and recommended [15]. However, the observed trend towards a less frequent use of distal protection devices in 2004 (480) as compared to 2003 (714) might continue, since a recent study revealed that they do not improve outcome in the setting of

primary PCI of native vessels [30]. Other adjunctive techniques were rarely employed, probably for scientific purposes.

Complications after PCI

As in previous years, there was a low rate of complications, which requires cautious interpretation. Due to the retrospective nature of this survey, there might be an underreporting of complications, e.g. patients who died after transfer to another hospital after PCI might not have been counted. Nevertheless, we know from the AMIS Plus registry that in patients with STEMI an increase in the proportion of primary PCI from 8.0 to 43.1% went parallel with a reduction of the in-hospital mortality from 12.2 to 6.7% between 1997 and 2002, and that simultaneously the mortality of patients undergoing primary PCI for STEMI has also significantly decreased over this period [24]. Although patients with STEMI constitute only a subset of patients undergoing PCI, they carry the highest risk, and thus might be representative to reflect trends in the evolution of complications.

Non-coronary interventions

The number of balloon valvuloplasties did not significantly change as compared to previous years, probably due to the fact that the diagnosis of congenital or rheumatic valve disease in adults has become rare. In contrast, patent foramen ovale is a frequent anatomical variant, and due to the association with stroke, especially in presence of an interatrial septal aneurysm, the diagnostic approach has become more aggressive, and the threshold for closure has become lower.

Limitations of the study

During the writing process of the paper, we became aware, that "ongoing myocardial infarction" had been interpreted inconsistently in different centres over the last years. Whereas some centres obviously reported only STEMI cases for this item, the whole spectrum of acute coronary syndromes was reported by most other centres. For 2005, we will give a precise definition for that item.

Conclusions

The number of CA and PCI, the frequency of stent placement in PCI, and the use of DES are steadily increasing over the last years. Due to full reimbursement of DES, Switzerland has an exceptionally high DES utilisation rate.

There is also a significant increase in number of interventions for closure of patent foramen ovale and atrial septal defect, whereas the number of balloon valvuloplasties has been more or less stable over the last years.

Appendix

Local coordinators

Aarau Kantonsspital:	A. Vuillomenet
Aarau Hirslanden Klinik:	P. Lüthy
Basel Universitätsspital:	C. Kaiser
Basel Claraspital:	B. Hornig
Bern Universitätsspital:	S. Windecker
Bern Klinik Beau-Site:	C. Noti
Bern Klinik Sonnenhof:	A. Garachemani
Bern Tiefenauspital:	H. Baur
Biel:	C. Röthlisberger
Chur Kantonsspital:	P. Müller
Genève Clinique des Grangettes:	P. Chatelain
Genève Hôpitaux Universitaires:	E. Camenzind
Genolier Clinique: Kreuzlingen	E. De Benedetti
Herzzentrum Bodensee:	M. Pieper
Lausanne Clinique Cecil: Lausanne Centre Hospitalier Universitaire	J.C. Stauffer
Vaudois:	E. Eeckhout
Lugano Cardiocentro:	G. Pedrazzini
Luzern Kantonsspital:	P. Erne
Luzern Klinik St. Anna:	R. Hämmerli
Meyrin Hôpital La Tour:	P. Urban
Sion Hôpital Régional:	P. Vogt
St. Gallen Kantonsspital:	D. Weilenmann
Winterthur Kantonsspital:	C. Neuen- schwander
Zürich Klinik Hirslanden:	P. Wadgi
Zürich Klinik im Park:	F.W. Amann
Zürich Triemli-Stadtpital:	E. Straumann
Zürich Universitätsspital:	F. Eberli

References

- 1 Meier B. Örtliche Entwicklung der Koronarangioplastie. *Schweiz Med Wochenschr* 1989;119:1033–9.
- 2 Meier B, Pfisterer M. Coronarographie, angioplastie percutanea transluminal coronaire et chirurgie coronaire, interventions valvulaires et anti-arrhythmiques et fibrinolyse pour infarctus aigu du myocarde en Suisse. *Schweiz Med Wochenschr* 1990;120:1559–64.
- 3 Meier B, Pfisterer M, Bertel O. Interventions cardiaque en Suisse. *Schweiz Med Wochenschr* 1992;122:432–40.
- 4 Rouvinez G, Bertel O, Urban P, Meier B. Herzeingriffe in der Schweiz 1992. *Schweiz Med Wochenschr* 1994;124:1284–94.
- 5 Röthlisberger C, Meier B, Urban P. Herzeingriffe in der Schweiz 1993. *Schweiz Rundsch Med Prax* 1995;84:402–11.

- 6 Goerre S. Herzeingriffe in der Schweiz 1994. Schweiz Rundsch Med Prax 1996;85:1071–80.
- 7 Goerre S. Herzeingriffe in der Schweiz 1995. Schweiz Rundsch Med Prax 1997;86:425–31.
- 8 Pedrazzini G. Herzeingriffe in der Schweiz 1996. Schweiz Rundsch Med Prax 1998;87:821–31.
- 9 Roffi M. Herzeingriffe in der Schweiz. 1997. Kardiovaskuläre Medizin 1999;2:302–18.
- 10 Roffi M. Herzeingriffe in der Schweiz. 1998. Kardiovaskuläre Medizin 2000;3:89–103.
- 11 Wahl A. Herzeingriffe in der Schweiz 1999. Kardiovaskuläre Medizin 2001;4:268–81.
- 12 Togni M, Meier B. Herzeingriffe in der Schweiz 2000. Kardiovaskuläre Medizin 2002;5:238–48.
- 13 Schlüter L, Rickli H, Vuillomenet A, Chatelain P, Eberli F, Meier B, et al. Interventions cardiaque percutanées en Suisse en 2001. Kardiovaskuläre Medizin 2004;7:61–70.
- 14 Reho I, Eberli F. Trends of percutaneous cardiac interventions in Switzerland (abstract). Kardiovaskuläre Medizin 2005;8(Suppl 8):S39.
- 15 Silber S, Albertson P, Avilés FF, Camici PG, Colombo A, Hamm C, et al., for the Task Force for Percutaneous Coronary Interventions of the European Society of Cardiology. Eur Heart J 2005;26:804–47.
- 16 Smith SC, Dove JT, Jacobs AK, Kennedy JW, Kereiakes D, Kern MJ, et al. ACC/AHA guidelines for percutaneous coronary intervention (revision of the 1993 PTCA guidelines) – executive summary: a report of the American College of Cardiology/American Heart Association task force on practice guidelines (Committee to revise the 1993 guidelines for percutaneous transluminal coronary angioplasty) endorsed by the Society for Cardiac Angiography and Interventions. Circulation 2001;103:3019–41.
- 17 Balmer F, Rotter M, Togni M, Pfiffner D, Zeiher AM, Maier W, Meier B. Percutaneous coronary interventions in Europe 2000. Int J Cardiol 2005;101:457–63.
- 18 Bruckenberg E. Herzbericht 2004 mit Transplantationschirurgie. Hannover: Eigenverlag; 2005, ISBN 3-00-01706-4; Website: www.bruckenberg.de.
- 19 TIME Investigators. Trial of invasive versus medical therapy in elderly patients with chronic symptomatic coronary-artery disease (TIME): a randomised trial. Lancet 2001;358:951–7.
- 20 Morice MC, Serruys PW, Sousa JE, Fajadet J, Ban Hayashi E, Perin M, et al. A randomised comparison of a sirolimus-eluting stent with a standard stent for coronary revascularization. N Engl J Med 2002;346:1773–80.
- 21 Stone GW, Ellis SG, Cox DA, Hermiller J, O’Shaughnessy C, Mann JT, et al. A polymer-based, paclitaxel-eluting stent in patients with coronary artery disease. N Engl J Med 2004;350:221–31.
- 22 Windecker S, Remondino A, Eberli F, Jüni P, Räber L, Wenaweser P, et al. Sirolimus-eluting and paclitaxel-eluting stents for coronary revascularization. N Engl J Med 2005;353:653–62.
- 23 Kaiser C, Brunner-La Rocca HP, Buser PT, Bonetti PO, Osswald S, Linka A, et al.; BASKET Investigators. Incremental cost-effectiveness of drug-eluting stents compared with a third-generation bare-metal stent in a real-world setting: randomised Basel Stent Kosten Effektivitäts Trial (BASKET). Lancet 2005;366:921–9.
- 24 Fassa AA, Urban P, Radovanovic D, Duvoisin N, Gaspoz JM, Stauffer JC, et al., for the AMIS Plus Investigators. Trends in reperfusion therapy of ST segment elevation myocardial infarction in Switzerland: six year results from a nationwide registry. Heart 2005;91:882–8.
- 25 Website: <http://www.amis-plus.ch>.
- 26 Widimsky P, Budesinsky T, Vorac D, Groch L, Zelizko M, Aschermann M, et al. Long distance transport for primary angioplasty vs immediate thrombolysis in acute myocardial infarction. Final results of the randomized national multicentre trial – PRAGUE-2. Eur Heart J 2003;24:94–104.
- 27 Stauffer JC, Radovanovic DR, Urban PU, Maggiorini MM, Bertel OB, Erne PE, on behalf of the AMIS investigators. Glycoprotein IIb/IIIa antagonists: what is their real impact on MACE rate and mortality in acute coronary syndromes? (abstract). Kardiovaskuläre Medizin 2005;8(Suppl 8):S34.
- 28 Nikolsky E, Mehran R, Halkin A, Aymong ED, Mintz GS, Lasic Z, et al. Vascular complications associated with arteriotomy closure devices in patients undergoing percutaneous coronary procedures. J Am Coll Cardiol 2004;44:1200–9.
- 29 Baim DS, Wahr D, George B, Leon MB, Greenberg J, Cutlip DE, et al. Randomized trial of a distal embolic protection device during percutaneous interventions of saphenous vein aorto-coronary bypass grafts. Circulation 2002;105:1285–90.
- 30 Stone G, Webb J, Cox D, Brodie B, Qureshi MA, Kalynych A, et al. Enhanced Myocardial Efficacy and Recovery by Aspiration of Liberated Debris (EMERALD) Investigators. Distal microcirculatory protection during percutaneous coronary intervention in acute ST-segment elevation myocardial infarction: a randomized controlled trial. JAMA 2005;293:1063–72.