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Amputations in PAD patients: Data from the German Federal Statistical Office

Nils Gutacker[1], Anja Neumann[2], Frans Santosa[3], Theodorus Moysidis[3] and Knut Kröger[3]

Abstract

Much effort has been spent to reduce the number of amputees within the last two decades, but it remains unclear how effective the different strategies have been. We analyzed the prevalence of amputations in inpatient cases in the federal statistics. Detailed lists of all amputations coded as major amputations (OPS 5-864) and minor amputations (OPS 5-865) performed in 2005 and 2006, divided into the 4th and 5th number of the OPS-code, were provided by the Federal Statistical Office. In 2006, a total of 62,880 amputations affecting the lower extremities (2005: 63,005) were performed in Germany. Because of multiple amputations within a single case the corresponding cases amounted to 55,705 in 2006 and 55,689 in 2005. Based on these data age-adjusted incidence rates of major amputations per 100,000 inhabitants increased from 2 at the age of < 50 years to 201 at the age of > 80 years. For minor amputations the prevalence rates increased from 4 at the age of < 50 years to 209 at the age of > 80 years. It can be assumed that peripheral arterial disease or neurovascular disease as the underlying disease necessitating the amputation were present in 74.9% of all inpatient cases who finally underwent amputation. There were 12.9% with non-vascular or non-diabetic reasons for amputations. In patients presenting with gangrene, the rate of minor amputations decreased with age, whereas the rate of major amputations increased, especially within the 8th to 10th decades of life. In conclusion, amputations affecting the lower limbs are still a relevant problem in Germany. At the time of an aging German population it has to be an important goal to lower or at least to stabilize the rate of amputations. The DRG statistics enable the Federal Ministry of Health and health politics to monitor amputation rates easily.

Keywords

amputation; diabetic foot syndrome; DRG statistics; peripheral arterial disease

Introduction

Prognosis of peripheral arterial disease (PAD) patients is predominantly determined by cardiac mortality and, to a lesser extent, by deterioration of peripheral perfusion.[1–3] Considering the total group of PAD patients, the amputation risk is low; however, looking at the subgroup of PAD patients suffering from chronic critical limb ischaemia, it is rather high. Much effort has been spent to reduce the number of amputees within the last two decades, but it remains unclear how effective the different strategies have been.

Based on their own local data some authors estimated a reduction in the rate of amputations over recent years. Analyzing the clinical records of 1094 patients undergoing major lower limb amputations for vascular disease in the town of Helsinki during the 13 years from 1990 to 2002 revealed a reduction of 23% in diabetics and 40% in non-diabetics.[4] The authors pointed out the contribution of vascular surgeons. Data from the Augsburg Medical Centre in Germany including 5379 patients treated between 1996 and 2003 reported that 627 underwent amputations, 1832 received a bypass procedure and 2920 a PTA. The incidences of the PTAs increased by 20%, whereas the number of amputations and bypass procedures remained stable.[5]

Until 2002 the federal statistics on hospitals included only the principal diagnosis. With the introduction of Diagnosis Related Groups (DRG) for reimbursement in 2003, additional diagnoses (i.e. co-morbidities and complications) and further information about procedures became

[1]Department of Medical Controlling and Quality Management, University Hospital Essen, Germany
[2]Alfried Krupp von Bohlen und Halbach, Stiftungslehrstuhl für Medizinmanagement, University Hospital Essen, Germany
[3]Department of Angiology, Helios Klinikum Krefeld, Germany

Corresponding author:
Knut Kröger
Klinik für Angiologie
HELIOS Klinikum Krefeld
Lutherplatz 40
47805
Krefeld, Germany
Email: knut.kroeger@helios-kliniken.de

Table 1. ICD-10 codes representing the different symptoms of peripheral arterial disease (PAD) and the vascular complications associated with diabetes mellitus which might cover the diabetic foot syndrome (NVD)

ICD code	Disease / symptoms
I70.20	Atherosclerosis of the lower extremity
I70.21	PAD, claudication
I70.22	PAD, rest pain
I70.23	PAD, ulcer
I70.24	PAD, gangrene
I73.1	PAD, Buerger's disease
I73.9	PAD, not specified
E10.50 / E10.51	Vascular complications associated with
E11.50 / E11.51	diabetes mellitus grouped as neurovascular
E13.50 / E13.51	disease (NVD)
E14.50 / E14.51	

available in 2005 as well. Using this information a detailed description of both prevalence and incidence of amputations in hospitalized patients in Germany was possible for the first time. Thus, we analyzed the prevalence and incidence of major and minor amputations in Germany. This information can be used as a basis for future monitoring of the prevalence of amputations and to optimize global strategies of the health system for prevention.

Patients and methods

The national statistics (DRG statistics) published by the Federal Statistical Office includes data from all hospitals in Germany that use the DRG system. These hospitals are legally obliged to deliver extensive data on hospital treatment, including demographic data, diagnoses, co-morbidities, complications, and procedures to the 'Institute for the Hospital Remuneration System' (InEK) which uses the data for a yearly adaptation of the German DRG system and transmits them to the Federal Statistical Office. For 2005 and 2006, all diagnoses were coded with the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10), which was adapted for Germany by the German Institute for Medical Documentation and Information (DIMDI) as ICD-10 German Modification (ICD-10-GM) in the corresponding annual version. PAD and neurovascular disease (NVD) were coded as shown in Table 1. Amputations were coded as major amputations (OPS 5-864) and minor amputations (OPS 5-865) (Table 2).

Statistics

Detailed lists of all amputations performed in 2005 and 2006, divided into the 4th and 5th number of the OPS-code, were provided by the Federal Statistical Office. In addition age- and sex-adjusted incidence rates were calculated for all cases for which amputations were coded. Cases were divided into those with PAD or NVD as the principal diagnosis, and those with amputation but a principal diagnosis other than PAD or NVD. It has to be pointed out that the analysis is based on cases and not on individual patients. As a consequence, a patient could be included several times in the statistics if he or she had an amputation at two different times within 1 year.

Calculations were done using Microsoft® Excel 2003 and Microsoft® Access 2003.

Results

In 2006, a total of 62,880 amputations affecting the lower extremities (2005: 63,005) were performed in Germany. Major amputations constituted 39% of all amputations; the most frequent level of major amputation was supragenual (OPS 5-864.5) with almost 40% of all major amputations in those years. Of minor amputations, 59% were toe amputations (OPS 5-865.7).

Because of multiple amputations within one single case the corresponding cases amounted to 55,705 in 2006 and

Table 2. Age-adjusted incidence of major (OPS 5-864) and minor (OPS 5-865) amputations per 100,000 inhabitants in Germany in 2005 and 2006, divided into all, males and females

	Age (years)	2005			2006		
		All	Males	Females	All	Males	Females
n		22,619			22,003		
Major	<50	2	3	1	2	3	1
(OPS 5-864)	50–59	18	28	7	19	31	8
	60–69	52	81	24	48	76	21
	70–79	109	155	74	103	150	68
	≥80	202	238	188	201	245	184
n		33,070			33,702		
Minor	<50	4	6	2	4	6	2
(OPS 5-865)	50–59	37	60	13	39	65	14
	60–69	89	144	37	87	143	35
	70–79	160	247	96	167	263	95
	≥80	208	295	174	209	299	174

Table 3. Total number of hospitalized patients with ICD covering peripheral arterial disease (I70.20–I73.9) and neurovascular disease (NVD, E10.50–E14.51) as principal diagnoses in the years 2005 and 2006 are listed. In addition, numbers and rates of those with major (OPS 5-864) and minor (OPS 5-865) amputations are given

ICD	2005					2006				
	Total *n*	Major		Minor		Total *n*	Major		Minor	
		n	Rate %	*n*	Rate %		*n*	Rate %	*n*	Rate %
I70.20	3,515	77	2.2	75	2.1	2,572	43	1.2	44	1.3
I70.21	64,545	122	0.2	92	0.1	66,078	122	0.2	80	0.1
I70.22	20,587	613	3.0	132	0.6	20,998	557	2.7	94	0.5
I70.23	17,407	1,266	7.3	1,366	7.8	19,383	1,201	6.9	1,390	8.0
I70.24	32,949	8,095	24.6	8,415	25.5	33,431	7,963	24.2	8,856	26.9
I73.1	613	25	4.1	64	10.4	635	17	2.8	53	8.6
I73.9	4,110	144	3.5	133	3.2	4,101	141	3.4	116	2.8
Subtotal	143,726	10,342	7.2	10,277	7.2	147,198	10,044	6.8	10,633	7.2
NVD	18,834	1,561	7.9	3,536	18.8	17,053	1,402	8.2	3,228	18.9
Total	162,560	11,903	7.3	13,813	8.5	164,251	11,446	7.0	13,861	8.5

ICD, International Statistical Classification of Diseases and Related Health Problems; NVD, neurovascular disease.

55,689 in 2005 (Table 2). Based on these data, the age-adjusted incidence rates of major amputations per 100,000 inhabitants increased from 2 at the age of < 50 years to 201 at the age of > 80 years. For minor amputations the prevalence rates increased from 4 at the age of < 50 years to 209 at the age of > 80 years.

In 2006, a total of 147,198 patients were hospitalized with the principal diagnosis of PAD. Major amputations (OPS 5-864) were performed in 6.8% (n = 10,044) and minor amputations (OPS 5-865) in 7.2% (n = 10,633) of all cases. Another 17,053 were hospitalized with a principal diagnosis that we assumed to cover NVD, and 8.2% (n = 1402) underwent a major and 18.9% (n = 3228) a minor amputation. The numbers were rather similar to the year 2005 (Table 3). In the case of claudication (ICD-code I70.21), the risk of amputation was very low (0.3%), but increased dramatically with the stage of disease. Half of those who where admitted to hospital with the principal diagnosis of gangrene (ICD-code I70.24) finally underwent amputation. In contrast, the prognosis in those with ulcers (ICD-code I70.23) was much better.

In 2006, the number of amputations in the group of patients with the principal diagnoses PAD and NVD, respectively, represented only 45.4% of all documented amputations. Thus, another 30,398 cases of those patients who were admitted to hospital with principal diagnoses other than those listed in Table 1 underwent amputations. In this group the most frequent principal diagnoses were endocrine disorders (grouped as E00-E90) and cardiovascular diseases (grouped as I00-I99) (Table 4). Endocrine disorders, especially as the underlying disease necessitating amputation, were coded as principal diagnoses in only 16,430 cases (29.5% of all cases with documented amputations). These endocrine disorders mainly consisted of E11.70 and E11.71 (diabetes mellitus with multiple complications) and covered the complete variety of diabetes mellitus. Thus, it can be assumed that the surgeons were aware of PAD or NVD as the underlying disease necessitating the amputation in 74.9% of all inpatient cases who finally underwent amputation.

Table 4. List of the most frequent principal diagnoses in those 30,398 amputees who underwent amputations without being coded under the principal diagnosis peripheral arterial disease (PAD) or neurovascular disease (NVD) listed in Table 1

ICD group	Description	Cases	Rate %
I00–I99	Cardiovascular diseases	2,340	7.7
E00-E90	Endocrine disorders	16,430	54.0
S00-T98	Injuries and toxicities	3,268	10.8
M00-M99	Musculoskeletal disorders	2,290	7.5
L00-L99	Diseases of skin and subcutaneous tissue	1,613	5.3
R00-R99	Symptoms and abnormal clinical or chemical findings	848	2.8
A00-B99	Infections and parasitic diseases	670	2.2
C00-D48	Cancer / malignant neoplasm	652	2.1
Q00-Q99	Congenital anomalies	152	0.5
N00-N99	Genitourinary diseases	134	0.4

ICD, International Statistical Classification of Diseases and Related Health Problems.

Reasons for non-vascular or non-diabetic amputations were injuries and toxicities, musculoskeletal disorders and diseases of skin and subcutaneous tissue, adding up to 7171 amputations (12.9% of all inpatient cases with amputation) (Table 4).

Table 5 shows that the variation of amputation rates depends on different clinical findings with age. In patients presenting with gangrene, the rate of minor amputation decreases with age whereas the rate of major amputation increases. These changes especially occur within the 8th to 10th decades of life. Amputation rates in patients presenting with rest pain (I70.20) and ulcers (I70.23) do not show such a shift from minor to major amputations with increasing age. In contrast to PAD, minor amputation rates are much higher than major amputation rates in patients suffering from NVD.

Table 5. Rate of minor and major amputations in 2006 of those patients with PAD and NVD, of those with critical ischaemia (I70.22+I70.23), of those with gangrene (I70.24) and of those with NVD (E10.50 / E10.51+E11.50 / E11.51+E13.50 / E13.51+E14.50 / E14.51) as principal diagnoses, divided into different age groups

	Total	≤50	51–60	61–70	71–80	81–90	>90
PAD+NVD							
All (*n*)	164,251	9,029	23,137	50,023	51,399	26,502	4,161
Rate of minor (%)	7.0	3.0	3.8	5.4	7.3	11.7	19.4
Rate of major (%)	8.5	6.1	2.8	1.5	1.7	3.7	27.7
Only chronic critical ischaemia (I70.22+I70.23)							
All (*n*)	40,381	1,564	4,309	10,773	13,344	8,950	1,441
Rate of minor (%)	3.7	1.9	2.9	3.6	4.0	3.9	4.6
Rate of major (%)	4.4	3.0	4.2	4.1	4.2	4.9	6.7
Females (*n*)	17,270	435	960	3,004	5,796	5,982	1,093
Rate of minor (%)	3.0	1.6	2.2	3.6	4.0	3.9	4.6
Rate of major (%)	4.4	2.3	3.6	3.7	4.2	4.7	6.6
Males (*n*)	23,111	1,129	3,349	7,769	7,548	2,968	348
Rate of minor (%)	4.3	1.9	3.4	3.9	5.0	5.0	7.5
Rate of major (%)	4.4	3.3	4.4	4.3	4.1	5.3	6.9
Only PAD with gangrene (I70.24)							
All (*n*)	33,431	942	2,725	8,181	11,110	8,469	2,004
Rate of minor (%)	26.7	32.6	31.1	29.7	27.3	22.2	20.6
Rate of major (%)	23.9	18.5	19.8	22.2	22.9	26.9	32.3
Females (*n*)	13,419	253	504	1,845	4,118	5,171	1,528
Rate of minor (%)	22.2	30.8	25.4	24.0	23.7	20.1	20.5
Rate of major (%)	25.6	27.4	20.0	21.7	23.0	27.4	33.8
Males (*n*)	20,011	689	2,221	6,335	6,992	3,298	476
Rate of minor (%)	29.7	33.2	32.2	31.4	29.5	25.3	20.8
Rate of major (%)	22.9	18.9	19.7	22.4	22.8	26.1	27.7
Only NVD (E10.50 / E10.51+E11.50 / E11.51+E13.50 / E13.51+E14.50 / E14.51)							
All (*n*)	17,053	688	2,079	5,201	6,047	2,729	309
Rate of minor (%)	19.0	24.3	19.7	19.1	18.8	17.0	21.0
Rate of major (%)	8.2	4.8	6.0	6.6	8.8	12.1	13.3
Females (*n*)	6,455	193	479	1,284	2,476	1,775	248
Rate of minor (%)	16.0	18.1	15.4	15.1	16.4	15.3	21.4
Rate of major (%)	8.9	2.1	5.0	6.5	8.7	12.0	14.5
Males (*n*)	10,598	495	1,600	3,917	3,571	954	61
Rate of minor (%)	20.8	26.7	21.0	20.4	20.4	20.2	19.7
Rate of major (%)	7.8	5.9	6.3	6.6	8.9	12.4	8.2

PAD, peripheral arterial disease; NVD, neurovascular disease.

Discussion

The present data are derived from the most reliable basis for the estimation of amputation rates in Germany, and the analysis shows that amputations are still a relevant problem in Germany.

Using routine data from the Local Health Insurance Funds (AOK) as well as previous analyses from Germany, the number of lower limb amputations in Germany was estimated at 43,544 in 2001.[6] Although the same OPS-codes (OPS 5-864 and 5-865) were included, this number is much lower than the number reported by us. The distribution of the level of amputations was rather similar to that derived from the DRG statistics: 44% of all amputations were major amputations compared with 39% in the DRG statistics, whereas the most frequent level of major amputation was supragenual (OPS 5-864.5) with around 31% of all major amputations in those years (40% in the DRG statistics). Of all minor amputations, 61% were toe amputations (OPS 5-865.7) (59% in the DRG statistics).

The overall population-based amputation rate estimated in this study in 2005 and 2006 was 68 per 100,000 people per year in Germany (major amputation (OPS 5-864): 27; minor amputation (OPS 5-865): 41). In 2000, the Global Lower Extremity Amputation Study Group published lower major amputation incidence rates from Japan, Taiwan, Spain, Italy, North America and England, based on data collected between July 1995 and June 1997.[7] These data were derived from different sources such as hospital discharge data, operating theatre records and limb-fitting centre records, but it was unfortunately not population-based. The highest amputation rates were in the Navajo population, United States (43.9 per 100,000 people per year for first major amputation in men) and the lowest in Madrid, Spain (2.8 per 100,000 per year). Thus, the rate of 27 major amputations per 100,000 people per year is within this range. The incidence of amputations increased steeply with age; most amputations occurred in patients over 60 years of age. In agreement with our data, in most centres the incidence was higher in men than women; but in contrast with

our data, the incidence of major amputations was greater than that of minor amputations.

Some authors describe a decrease in major amputation rates among diabetic as well as non-diabetic patients and discuss an attribution to the increased interest in amputation prevention, with a contribution either by vascular surgeons or a network of specialized physicians as the causal reason.[4,8] The database of the studies that led to such a conclusion is questionable. A Finnish study is based only on retrospective clinical records of 1094 patients undergoing major lower limb amputations for vascular disease in the town of Helsinki during the 13 years from 1990 to 2002.[4] A German study analyzed medical records of 692 patients who had received non-traumatic lower-limb amputations in 1990–1991 and 1994–2005 and calculated incidence rates for the estimated German diabetic population.[8] These incidence rates in the diabetic population per 100,000 person-years varied considerably between years (maximum 549 in 1990, minimum 281 in 2004). In Geneva (Switzerland), the rate of amputations observed among elderly patients (> 65 years) was low, with 1.8–11.4/10,000 patients/year, but amputations did not improve from 1995 to 2005.[9]

PAD in general is accountable for 79–84.6% of all amputations.[9–11] According to the documentation in the German DRG system, only 74.9% account for PAD or vascular complications associated with diabetes mellitus, as this analysis shows. This lower dominance of PAD or diabetes mellitus associated with amputations can be interpreted in different ways. It could be an effect of good care of these patients, but it could also be seen as a result of a high number of traumatic or malignant diseases necessitating amputation in Germany. Finally, miscoding has to be discussed as a possible explanation.

Only 45.4% of all amputations were performed in the group of patients with a principal diagnosis of PAD or NVD. Excluding patients with traumatic or malignant disease, a large group of patients underwent amputations due to PAD or NVD without having these principal diagnoses. The reasons for this mismatch of primary diagnoses and amputations remain unclear.

As Table 3 mirrors, most of the inpatients with the principal diagnosis of PAD suffered from claudication (ICD 70.21). In accordance with the international guidelines, claudication[1–3] should be treated primarily conservatively. Only in the case of a very short claudication distance or detected inflow obstruction is interventional or open surgical treatment justified. Unfortunately, the ICD codes and DRGs, respectively, do not imply any information on whether these criteria were fulfilled in the group treated for claudication. In any case, treatment of claudication should be technically safe and efficient. In the case of claudication, an amputation could become necessary only in the case of complication, and it has to be critically discussed whether a rate of 0.3% of amputees within patients with the principal diagnosis claudication could be seen as acceptably low.

Even amputation rates related to ICD I70.20 (atherosclerosis of lower extremities) and ICD I73.9 (PAD not specified diagnosis) are relatively high. Miscoding as well as treatment complications could be possible explanations, but the DRG statistic does not give detailed information.

On the other hand, Table 3 shows that only half of those who had the principal diagnosis of gangrene (ICD 70.24) underwent amputation. As gangrene is defined as irreversible tissue damage, one could have expected an amputation rate of nearly 100%. Unfortunately the principal diagnosis of gangrene does not provide information regarding the extension of the gangrene. Thus, this group of patients covers small distal toe gangrene as well as extended gangrene of the complete limb. It can be assumed that a number of patients with less gangrene leave hospital to wait for spontaneous demarcation and undergo amputations finally in an out-of-hospital setting. Others could have died before final amputation was performed or even refused amputation.

Primary amputation is a recommended procedure in very old patients suffering from irreversible tissue damage to prevent repetitive partial amputations requiring longer hospital stays and a number of anaesthesia procedures.[1–3] The shift from minor to major amputations in older patients presenting with gangrene, shown in Table 5, goes along with this recommendation. Thus, older people are not only at a higher risk of developing PAD or NVD, they are obviously also at a higher risk for major amputations when presenting with gangrene.

Limitations

Although routine data in the electronic patient record are frequently used for secondary purposes, there is currently no systematic analysis of coding quality in Germany.[12,13] Whether coding matches reality as a prerequisite for further use of the data in medicine and health politics has to be investigated in controlled trials. Thus, we cannot estimate the rate of wrong coding of PAD and vascular complications associated with diabetes mellitus or even stage of PAD.

As the choice of primary diagnosis is on the physician's own authority and strongly affects the reimbursement in the German DRG system, one might be motivated to replace PAD or NVD as the primary diagnosis with other additional diagnoses. Therefore, we recommend further health economic studies to quantify the effects and incentives of upcoding in the treatment of PAD in Germany.

In conclusion, there were still more than 62,880 amputations performed in Germany in 2006. We do not have any information about the time line of these figures. At the time of an aging German population it has to be an important goal to lower or at least to stabilize the rate of amputations. The DRG statistics enable the Federal Ministry of Health and health politics to monitor amputation rates easily.

Although the DRG statistics are a reliable database regarding the total number of amputations, it does not give any information about the quality of medical treatment, and the information about the underlying diseases are sparse. Thus, the causality of each single amputation cannot be properly determined. An accompanying analysis of individual case management of the hospitalized patient, but also of the pre-hospital period, is mandatory to recognize possible strategies to prevent amputations completely.

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