



## Percutaneous endovascular treatment of peripheral arterial disease in Germany☆



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### ABSTRACT

**Purpose:** The general distribution of balloon angioplasty, stenting and other endovascular interventions in treating peripheral arterial disease (PAD) is unclear.

**Methods and results:** We used national statistics (DRG statistics) published by the Federal Statistical Office including data from almost all hospitals in Germany to calculate the rates and types of lower extremity endovascular procedures in 2012. In 2012 150,503 peripheral endovascular procedures were documented in Germany. The predominant procedures were percutaneous transluminal angioplasty (PTA) with 86.0% followed by thrombolysis with 7.2% and thrombectomy with 2.9%. In 50,092 (33.3%) of all peripheral endovascular procedures performed in the lower limb arteries a stent was placed: 66.7% in iliac, 34.3% in femoro-popliteal and 9.7% in cruro-pedal procedures. From these 50,092 procedures DES were coded in 3063 (6.1%) and covered stents in 1841 (3.7%). The highest rate of covered stents was placed in the aorta (8.6%) but the highest rate of DES was in the cruro-pedal arteries (23.1%).

**Conclusion:** Pure PTA is still the most frequently performed procedure in peripheral arteries and in only one third of all procedures was a stent placed in Germany in 2012.

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## 1. Introduction

Technical success of endovascular treatment of peripheral arterial disease (PAD) has increased in the last decades. With the introduction of new technology (hydrophilic guide-wires, stents, stent grafts) success rates up to 100% are reported in the literature [1–4]. Stent placement has been established in case of failure of primary angioplasty or early restenosis. But also primary stenting is accepted because of higher patency rates and lower complication rates [5–7]. Although residual stenosis, elastic recoil or dissections are accepted indications for stent placement, the decision to place a stent is the individual decision of the interventionalist based on his education and experiences. There are no guidelines that strictly recommend stent placement in specific situations. Randomized controlled studies present only selected patients and studies reporting the results of single centers do not necessarily represent the global country.

Exact data about the general frequency of stent placement in peripheral arteries are missing until today. Such data are necessary to estimate

relevant changes in the global treatment strategies over years or in different countries. Therefore we analyzed the numbers and types of percutaneous endovascular procedures of peripheral arteries (PA) in a nationwide survey to get an overview of treatment strategies in Germany.

## 2. Material and methods

In Germany Diagnosis Related Groups (DRGs) were implemented for reimbursement in 2003. The national statistics (DRG statistics) published by the Federal Statistical Office includes data from all hospitals in Germany that use the DRG system which covers more than 99% of all German hospitals. These institutions are legally obliged to document 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 the year 2012 all procedures were coded with the International Statistical Classification of Diseases and Related Health Problems, which was adapted for Germany by the German Institute for Medical Documentation and Information (DIMDI). Codes for stent placement were introduced in 2009 for the first time.

☆ No conflicts of interest.

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**Table 1**

Systematic of OPS-codes for documentation of endovascular treatment of PAD separated by the 5th and 6th figure.

8-836.**	Percutaneous trans luminal angioplasty
8-836.0*	Balloon Angioplasty (Balloon)
8-836.1*	Blade-Angioplasty (scoring- or cutting-balloon)
8-836.2*	Laser Angioplasty
8-836.3*	Atherectomy
8-836.6*	Distraction of foreign body
8-836.7*	Selective Thrombolysis
8-836.p*	Rotational thrombectomy
8-836.r*	Cryoplasty
8-836.w*	Atherectomy with embolism protection device
8-836.*4	Aorta
8-836.*9	Other abdominal arteries (predominantly iliac arteries)
8-836.*b	Femoro-popliteal arteries
8-836.*c	Cruro-pedal arteries
8-840.**	Percutaneous trans luminal placement of BMS
8-841.**	Percutaneous trans luminal placement of DES
8-842.**	Percutaneous trans luminal placement of covert stent
8-840.0*	1 stent
8-840.1*	2 stents
8-840.2*	3 stents
8-840.3*	4 stents
8-840.4*	5 stents
8-840.5*	6 or more stents

**2.1. Statistics**

Detailed lists of all cases with a documented peripheral percutaneous procedures performed in 2012 separated by the 5th and 6th figure of the OPS-code were provided by the Federal Statistical Office (Table 1). The lists were analyzed in detail to extract data regarding the aorta (6th figure 4) and other abdominal arteries (representing the iliac arteries predominantly) (6th figure 9), femoro-popliteal (6th figure b) and cruro-pedal arteries (6th figure c). All other codes were excluded. These codes were further analyzed for the 5th figure encoding the type of procedure.

For those cases that had a code 8.836.\*4, 8.836.\*9, 8.836.\*b, 8.836.\*c defining a percutaneous transluminal angioplasty (PTA) we had detailed lists of coded stents in addition. Stent coding differentiates in bare metal stents (8.840.\*\*, BMS), drug eluting stents (8.841.\*\*, DES) and covered stents (8.842.\*\*, CS) and in the number of placed stents within one specific procedure. The figures presented express

cases so that a single patient undergoing multiple interventions within one year can occur more than once. Calculations of sums and percentages were done using Microsoft® Excel 2003 and Microsoft® Access 2003.

**3. Results**

In 2012 150,503 percutaneous procedures for revascularization of the aorta, other abdominal arteries, the femoro-popliteal and the cruro-pedal arteries were documented in Germany. The predominant percutaneous procedures were balloon angioplasty (PTA) with 86.0% followed by thrombolysis with 7.2% and thrombectomy with 2.9%. All other techniques including the use of LASER, cutting balloon, atherectomy devices or cryoplasty summed up to only 3.9%. Some of these procedures were done within the same treatment process within one patient to achieve an effective lumen. Thus the number of affected patients should be lower (Table 2).

The femoro-popliteal arteries were the most frequently treated segment with 76,453 (50.8%) percutaneous procedures followed by the cruro-pedal arteries with 43,789 (29.1%). Balloon angioplasty was the most frequently used technique in all peripheral arterial segments, but the rate of thrombolysis and thrombectomy increased from proximal to distal. Thus, in the cruro-pedal arteries thrombolysis was documented in 10.0% of the cases and thrombectomy in 5.4%.

In 50,092 (33.3%) of all percutaneous procedures performed in the lower limb arteries a stent was placed. From these 50,092 procedures DES were coded in 3063 (6.1%) and covered stents in 1841 (3.7%). The rate of procedures associated with stent placement decreased from proximal to distal. In two thirds (66.7%) of all percutaneous procedures performed in the other abdominal arteries (predominately iliac arteries) a stent was placed, but only in one third (34.3%) of procedures performed in the femoro-popliteal arteries and in one tenth (9.7%) of the cruro-pedal procedures. In the aorta the proportion of covered stents was highest (8.6% of all procedures with stent) while the highest rate of DES was found in the cruro-pedal arteries (23.1%). If a stent was placed, in 24.9% (n = 12,495) two or more stents were placed and in 4.9% (n = 2473) three or more stents respectively (Table 3).

Although 62.4% of all procedures were performed in male patients we did not find any gender difference in treatment regarding the rate of thrombolysis, rate of stents and kind of stents.

**Table 2**

Type of procedure, absolute numbers and rates of procedures separated for the different peripheral arterial segments (all includes all procedures coded as 8-836.0, 8-836.1, 8-836.2, 8-836.3, 8-836.6, 8-836.7, 8-836.8, 8-836.p, 8-836.r, 8-836.w for this segment).

Segment/OPS Codes	Type of Procedure	Total		Males		Females	
		n	Stents N/%	n	Stents N/%	n	Stents N/%
<b>Aorta</b>							
8-836.*4	<b>all</b>	<b>1414</b>	<b>405 (28.6)</b>	<b>923</b>	<b>206 (22.3)</b>	<b>491</b>	<b>199 (40.5)</b>
8-836.04	<b>Balloon angioplasty</b>	1328 (93.9)		874 (94.7)		453 (92.3)	
8.836.74	<b>Thrombolysis</b>	15 (1.1)		7 (0.5)		8 (0.6)	
8.836.84	<b>Thrombectomy</b>	10 (0.7)		7 (0.5)		3 (0.2)	
<b>other abdominal arteries</b>							
8-836.*9	<b>all</b>	<b>28,874</b>	<b>19,252 (66.7)</b>	<b>19,594</b>	<b>13,007 (66.4)</b>	<b>9373</b>	<b>6234 (66.5)</b>
8-836.09	<b>Balloon angioplasty</b>	27,565 (95.5)		18,664 (95.3)		8898 (94.9)	
8.836.79	<b>Thrombolysis</b>	624 (2.2)		383 (2.0)		241 (2.6)	
8.836.89	<b>Thrombectomy</b>	170 (0.6)		106 (0.5)		64 (0.7)	
<b>Femoro-popliteal arteries</b>							
8.836.*b	<b>all</b>	<b>76,453</b>	<b>26,199 (34.3)</b>	<b>46,057</b>	<b>15,613 (33.9)</b>	<b>29,654</b>	<b>9933 (33.5)</b>
8-836.0b	<b>Balloon angioplasty</b>	64,718 (84.7)		39,061 (84.8)		25,652 (86.5)	
8.836.7b	<b>Thrombolysis</b>	5740 (7.5)		3431 (7.4)		2309 (7.8)	
8.836.8b	<b>Thrombectomy</b>	1840 (2.4)		1307 (2.8)		859 (2.9)	
<b>Cruro-pedal arteries</b>							
8-836.*c	<b>all</b>	<b>43,789</b>	<b>4236 (9.7)</b>	<b>27,287</b>	<b>2659 (9.7)</b>	<b>16,438</b>	<b>1577 (9.6)</b>
8-836.0c	<b>Balloon angioplasty</b>	35,780 (81.7)		22,559 (82.7)		13,217 (80.4)	
8.836.7c	<b>Thrombolysis</b>	4395 (10.0)		2622 (9.6)		1773 (10.8)	
8.836.8c	<b>Thrombectomy</b>	2352 (5.4)		1307 (4.8)		1045 (6.4)	

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