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Gender Differences in Vascular Interventions for Lower Limb Ischaemia

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Objectives: *to investigate changes in intervention for lower limb ischaemia with regard to gender.*
Material and method: *type of procedure, the age and gender of all patients (8687) undergoing interventions (12 295) for lower limb ischaemia in Stockholm 1970–1994, were obtained from the National Board of Health and Welfare.*
Results: *interventions rose from 18 per million inhabitants in 1970 to 786 in 1994. The proportion of women treated grew from 34% to 48%. The number of embolectomies decreased from 80 to 69 per million. Infrainguinal reconstructions increased most from 38 in 1980–1984 to 186 per million inhabitants in 1990–1994, with the proportion of women increasing from 33 to 43%. Mean age increased from 63 to 71 years.*
Conclusions: *there was a marked increase in the number of procedures, the proportion of female patients and mean age.*

Key Words: Lower limb ischaemia; Women; Gender difference; Vascular interventions; Epidemiology.

Introduction

There is a continuing increase in the number of vascular interventions performed in Sweden, Finland and several other European countries.[1–3] This may be due to improvements in techniques, but also because of the increasing number of elderly women in the population.[4–8]

The principal aim of this study was to identify changes over time in type of procedure performed as well as the age and gender of patients undergoing vascular surgery for lower limb ischemia. The study is based on data from the Swedish National Board of Health and Welfare during a 25-year period for the County of Stockholm, Sweden.

Material and Methods

All patients treated at Swedish hospitals are registered according to the International Classification of Diseases (ICD) into a computerised register controlled by the Register of National Board of Health and Welfare (NBHW). During the study period the ICD 8 (1970–1979) and 9 (1980–1994, revised 1987) were used (Table 1).

Hospital admission records were requested for all interventions for lower limb ischaemia (LLI) for the County of Stockholm. Apart from the code for the surgical intervention and dates for the hospital stay, we also requested the patient's personal registration number, thereby obtaining age, sex and a possibility to analyse data not only as the number of interventions performed, but also the actual patients treated. Before 1979, operations were classified as embolectomy, thrombectomy, thrombendarterectomy, or "arterial bypass operation". After 1979 the classification became more detailed.

All vascular procedures for LLI extracted were defined as "all vascular interventions" (Table 1). From that group, four specified subgroups (embolectomy, suprainguinal procedure, femoropopliteal or femorodistal bypass) were analysed separately.

The population in the County of Stockholm increased from 1.48 million in 1970 to 1.71 million inhabitants in 1994 (19% of the Swedish population). The proportion of persons above 55 was unchanged (24%), as was the proportion of women above 55 (57%). In 1970, 28 882 were over 80 compared to 68 189 in 1994. At both time points 70% were women.

From 1970 to 1994, 12 295 vascular interventions (5378 in women, 6917 in men) were performed in 8687 patients (3836 women, 4808 men) (Table 2). The Swedish Data Inspection Board, the Swedish National

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Table 1. Requested ICD-codes for vascular interventions for LLI in 1970–1994.

	ICD-code	Type of procedure	Classification in the study
1970–1979	8802	Embolectomy	Embolectomy
	8864	Thrombectomy	Thrombectomy
	8803		
	8804	Thrombendarterectomy	Thrombendarterectomy
	8894–8898	Redo surgery	Redo surgery
	9921–8823	All vascular interventions	All vascular interventions 1970–1979
	8829		
	8750–8799	Amputation	Amputations during same hospital stay
1979–1994	8802	Embolectomy	Embolectomy
	8864	Thrombectomy	Thrombectomy
	8803		
	8884	Aortoiliac bypass	Aortoiliac procedure/suprainguinal
	8885	Iliacofemoral bypass	
	8814–8818	Thrombendarterectomy	
	8862	Femoro–femoral bypass	
	8865	Extraanatomical bypass	
	8861		
	8868		
	8886–8887	Femoropopliteal bypass	Femoropopliteal bypass
	8824	Profundoplasty	
	8827	Thrombendarterectomy	
	8826		
	8825	Femorodistal bypass	Femorodistal bypass
	8894–8898	Redo surgery	Redo surgery
	0967	PTA	PTA (after 1987)
	8750–8799	Amputation	Amputations during same hospital stay

Table 2. Mean age defined as age at first vascular intervention, standard deviation and numbers of patients treated for each procedure type during the different periods. Mean age during the whole period for women and men treated with different procedure types is presented.

Type of procedure	1970–1974	1975–1979	1980–1984	1985–1989	1990–1994	Mean age for women and men	
Suprainguinal†	—	—	64 ± 11	67 ± 10	68 ± 11	Women	68 ± 11
			$n = 525$	$n = 649$	$n = 811$	Men	65 ± 11*
Femoropopliteal†	—	—	66 ± 10	70 ± 10	72 ± 10	Women	73 ± 10
			$n = 240$	$n = 418$	$n = 938$	Men	68 ± 10*
Femorodistal†	—	—	68 ± 11	70 ± 12	74 ± 10	Women	76 ± 10
			$n = 34$	$n = 127$	$n = 437$	Men	71 ± 10*
Embolectomy	72 ± 12	73 ± 13	73 ± 12	75 ± 13	78 ± 11	Women	78 ± 12
	$n = 125$	$n = 254$	$n = 572$	$n = 539$	$n = 557$	Men	71 ± 12*
All interventions	63 ± 12	63 ± 14	66 ± 14	70 ± 13	71 ± 12	Women	71 ± 14
	$n = 609$	$n = 1003$	$n = 1554$	$n = 1771$	$n = 3707$	Men	66 ± 13*

† The type of procedure was not specified in the ICD codes 1970–1979.
* $p<0.001$ according to Student's *t*-test between women and men.

Board of Health and Welfare, and the local ethics committee all approved the study.

Statistics

Comparison between group means was performed with students *t*-test or with one way analysis of variance ANOVA (*F*-test).

Distributions between the groups were tested with the chi-square analysis.

The register of the NBHW has not previously been validated for data concerning vascular interventions. Therefore a random sample of 644 patients' records (5%) was chosen for validation. Records for 546 patients were found (85%), leaving 98 patients not possible to investigate in this respect.

In comparison with data extracted from the register and from release notes, 13 faults were found in the register, mainly regarding duration of hospital stay. When the register data were compared with the operative charts, four faults were found in the register, three of which were double coding of the same procedure.

In conclusion, the accuracy of the material withdrawn from the register was considered to be satisfactory.

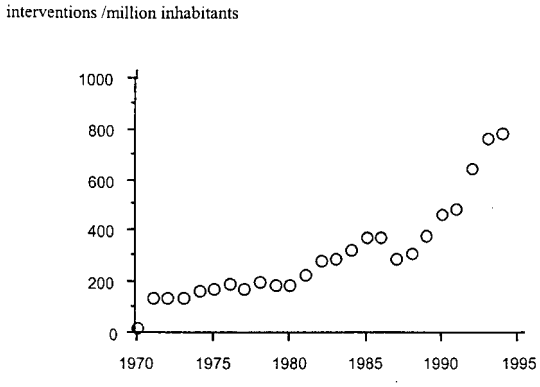

Fig. 1. All vascular interventions from 1970 to 1994 presented as annual number per one million inhabitants.

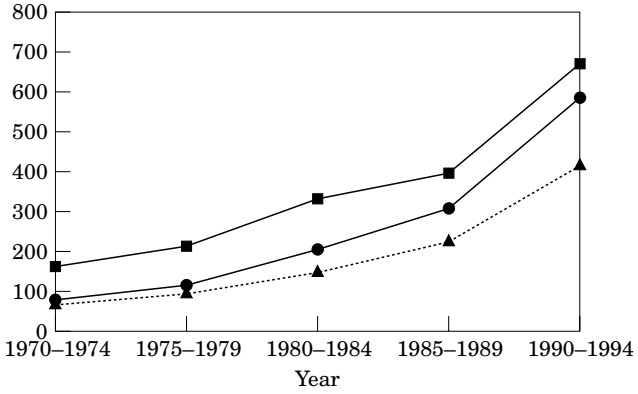

Fig. 2. Observed annual number of all vascular interventions per one million inhabitants for women and men. Age-adjusted number of interventions for women, standardised to men during the same 5-year period, is also presented. –●– Women; –▲– women age-standardised to men; –■– men.

Table 3. Annual incidence of operations per one million inhabitants for all procedure types during each five-year period. The proportion of interventions performed on women is presented in brackets as a percentage.

Type of procedure		1970–1974	1975–1979	1980–1984	1985–1989	1990–1994
Suprainguinal†	Women	—	—	51 (34)	79 (41)	96 (41)
	Men			101	112	135
Femoropopliteal bypass†	Women	—	—	22 (33)	49 (40)	123 (48)
	Men			45	73	135
Femorodistal bypass†	Women	—	—	3 (33)	12 (34)	49 (43)
	Men			6	23	65
Embolectomies	Women	30 (45)	43 (40)	75 (47)	77 (55)	77 (56)
	Men	36	64	84	64	60
All vascular interventions	Women	80 (33)	115 (35)	205 (38)	309 (44)	588 (47)
	Men	165	215	333	398	675

† The type of procedure was not specified in the ICD codes 1970–1979.
Chi square analysis for trend, analysing the proportion of interventions performed on women over time was significant for all groups ($p<0.001$).

Results

Time trends

The number of vascular interventions increased significantly ($p<0.001$) over time, from 18 per one million inhabitants in 1970 to 786 in 1994 (Fig. 1). The proportion of women also grew significantly ($p<0.001$) from 34% in 1970 to 48% in 1994. Similar figures were found when analysing the proportion of interventions performed in women (Table 3).

Mean age increased by 8 years, from an average of 63 in 1970–1974 to 71 years in 1990–1994. The gender difference in mean age varied from 3 years for suprainguinal procedures to 6.5 years for embolectomies, with an average significant 5-year age difference between women and men (Table 2). The age-adjusted incidence, where women are age-standardised to men during the same 5-year period, is illustrated by Figure 2. The proportion of women would have been lower if women had been of the same age as treated male patients.

Type of procedure

Changes in the distribution of the four procedure types are analysed over time. During the first period with appropriate ICD-coding, the number of embolectomies dominated (Fig. 3). In 1990–1994 a majority of infrainguinal procedures (femoropopliteal and femorodistal bypass) was found. The distribution of the procedures in female patients 1980–1994 (suprainguinal procedures 32%, femoropopliteal bypasses, 27% femorodistal bypasses, 9% and embolectomies 32%, $n=2983$) was significantly different when compared to male patients (suprainguinal procedures 38%, femoropopliteal bypasses 28%, femorodistal bypasses 11% and embolectomies 23%, $n=3541$) ($p<0.001$). The

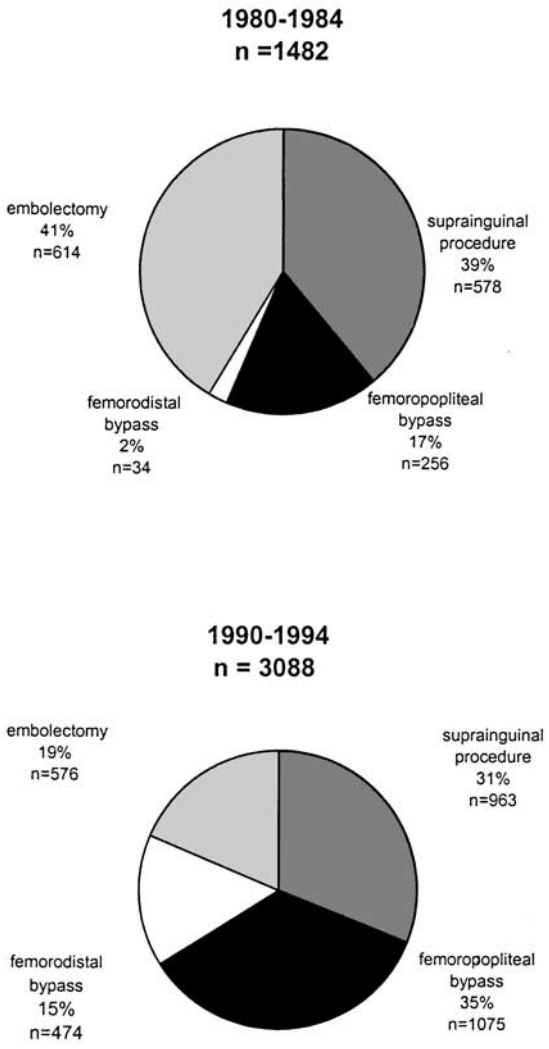

Fig. 3. The distribution of procedure types at the first analysed period (1980–1984) and the last (1990–1994). Pearson's chi-square statistic shows chi-square = 477, df = 3, $p<0.001$. The anatomical site for embolectomies was not specified.

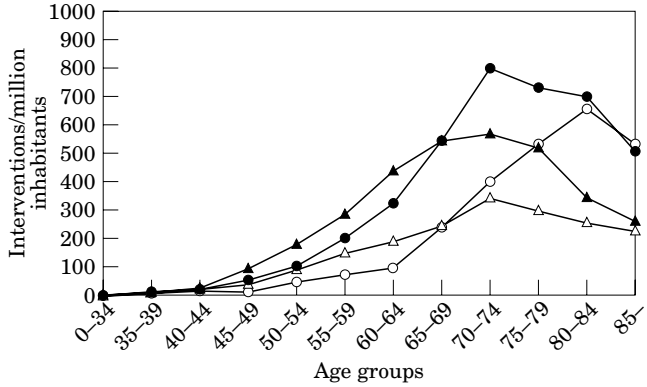

Fig. 4. Age-specific incidence presented for women and men treated with supra and infrainguinal procedures in 1980–1994. (–△–) Suprainguinal procedures in women; (–▲–) suprainguinal procedures in men; (–○–) infrainguinal procedures in women; (–●–) infrainguinal procedures in men.

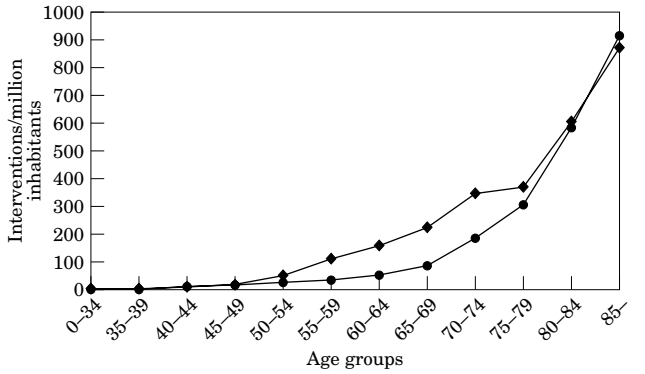

Fig. 5. Age-specific incidence presented for women and men embolectomised in 1970–1994. (–◆–) Embolectomised men; (–●–) embolectomised women.

changes over time for all procedure types are listed in Table 3. During the entire period, the incidence of femorodistal bypasses performed increased while the incidence of embolectomies decreased. The significant reduction in the number of embolectomies after 1980 was due to diminishing numbers of operations in male patients (Table 3). Embolectomies were the only subgroup where most interventions were performed on female patients (58%).

The age-specific incidence for the procedure types for lower limb ischaemia is presented in Figures 4 and 5. For suprainguinal procedures, the highest incidence occurred for both men and women at age 70–74. For the infrainguinal procedures the highest incidence was at 70–74 years for men and 80–84 for women. Among embolectomised patients, the increase in incidence was parallel for both sexes.

Discussion

This study emphasises the rapid and dramatic development in vascular surgery for LLI that has occurred in the County of Stockholm during the last 25 years. Similar trends have been described previously.[9–11]

The characteristics of patients subjected to vascular surgery for LLI also appears to have changed. Vascular surgeons may be treating a growing number of elderly female patients.

The true incidence of LLI in Sweden and its change over time is not known. The overall prevalence of LLI may, however, be rising due to the ageing population.[12] The proportion of people older than 55 years has been stable over the last 25 years (24%). Estimation of

the prevalence according to data from the Edinburgh Artery Study shows a modest increase in patients potentially requiring vascular intervention in our population.[13]

Increased prevalence of diabetes may also result in a higher incidence of LLI,[14] especially for women. The incidence of diabetes in Sweden has, however, been fairly stable since 1980. One might anticipate a lower incidence of LLI due to a decrease in smoking.[15]

Improved knowledge of the disease and its treatment in the population and among general practitioners is probable.[16]

Improved surgical technique and an increase in the number of trained vascular surgeons in our area may have enhanced referral numbers and most probably also widened the indication for vascular interventions for lower limb ischaemia. The increasing mean age over time in our material suggests a more generous attitude towards treating older patients, the majority of whom are women (Table 2). However, proportionally fewer operations are still performed on women in the same age group.

New techniques in radiology and angiology may also explain the increase in the number of interventions. Offering angioplasty to patients with milder symptoms not yet suitable for vascular surgery may have contributed.[17,18]

The number of suprainguinal procedures increased slightly over time but did not present the same dramatic increase as infrainguinal procedures.[19] The gender differences in mean age (3 years) are also less pronounced. A stable proportion of female patients, 41%, are also found over the observed period; other authors have found similar results of 39% and 42%.[20,21] The reported decline in smoking habits could perhaps explain the modest increase in operations performed.[15] Smoking affects suprainguinal arteriosclerotic development more than infrainguinal and 70–90% of all patients with suprainguinal disease are or have been smokers.[20,22] The suggestion that suprainguinal disease is a separate arteriosclerotic disease with less gender differences affecting younger patients with a particularly heavy load of risk factors is supported by this material.[4,23]

Patients treated with embolectomy are characterised by a decline in the number of procedures in men, a majority of women and the largest gender difference in mean age when compared to other procedure types. A reduction in the overestimation of embolic events versus thrombosis[24] and an increasingly older female population can explain the results. Other factors affecting the intervention rate could be a decreasing incidence of embolic events, better prophylaxis, and the introduction of thrombolytic therapy.

There is a need to estimate future vascular surgical workload: for economic forecasting, healthcare planning and for training. If we base the regression analysis on the number of interventions performed during the whole observed period, the annual incidence will be 950 interventions per million in 2010. If, instead, we use the years 1985–1994, the estimated incidence would be 1550. The latter analysis is probably more accurate since the number of interventions performed in the first decade is very low and unspecified. When predicting the development for the procedure types, we found that a majority of patients treated with femoropopliteal bypasses before 2005 will be women.

Conclusion

The main findings are an exponential increase in infrainguinal procedures during the last decade performed on increasingly older patients and an estimation that a majority of patients treated with femoropopliteal bypasses in a near future will be women. As the increase in vascular interventions is likely to continue for some time, measures should be taken to address its consequences.

Such measure could include increasing awareness of the disease in the general population, improving techniques for patient selection, research to find alternative treatment as well as healthcare planning.

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