

Treatment of chronic upper limb ischaemia is safe and results are good

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ABSTRACT

INTRODUCTION: Chronic ischaemia of the upper extremity is rare, and only a few small studies are published on results after revascularisation. We found it of interest to present this larger population-based registry-study of patients treated for chronic ischaemia of the upper limb by open or endovascular procedures.

MATERIAL AND METHODS: A total of 101,725 primary arterial vascular procedures in the Danish National Vascular Registry (Karbase) were recorded from 1.1.1993 to 31.12.2011. Of these, a total of 453 (0.4%) procedures were performed for chronic stenotic disease of the proximal arteries of the upper limb, 233 endovascularly and 220 by open surgery.

RESULTS: Open reconstructions: Two patients died within 30 days, which is equivalent to a mortality rate of 0.9%. Six (2.7%) reconstructions occluded before discharge. Complications were observed in 41 patients (19%); the complications were predominantly related to surgical wound. At follow-up, 74 (70%) had no symptoms. Endovascular reconstructions: There were six deaths within the first 30 days, which is equivalent to an early mortality rate of 2.6%. Four (2%) reconstructions occluded before discharge. Complications were observed for 23 (10%) patients; the complications were predominantly of neurovascular origin. At follow-up, 90 (74%) had no symptoms. The one-year survival was 95% with no difference between the two groups.

CONCLUSION: Chronic ischaemia of the upper limb can be treated both with open surgery and endovascularly with acceptable results. There was an excellent one-year patency rate for the patients who showed up for follow-up; the patency rate was comparable to that reported in the literature.

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Pain in the upper limb is usually caused by musculoskeletal disorders but may in rare cases be caused by arterial ischaemia. Ischaemia of the upper limb is best known in the acute form where patients present with sudden onset of pain, pallor, paresis, paraesthesia and pulselessness, i.e. the five Ps. The aetiology of sudden onset of symptoms is mainly thrombo-embolic, but can be traumatic or iatrogenic. In some instances, the ischaemic clinical presentation can be less pronounced with mus-

cular fatigue developing over weeks to months and can progress to rest pain or peripheral tissue loss. Over long periods, the clinical picture can easily be misinterpreted as other conditions, e.g. cervical spondylosis. The diagnosis is easily established by measurement of a lowered blood pressure in the affected arm (normal blood pressure in the contralateral), ultrasound-duplex examination and confirmation by arteriography (conventional or computed tomography).

The underlying cause of chronic ischaemia of the upper limb is primarily stenotic atherosclerotic lesions in the proximal part of the arteries of the upper limb, most often in the subclavian artery or the brachiocephalic trunk. Besides watchful waiting, treatment modalities for severe symptoms include revascularisation by open surgery or endovascular procedures. Today, revascularisation by endovascular methods is often the first choice if technically possible, whereas open surgery is reserved as second treatment choice.

Endovascular dilatation, percutaneous transluminal angioplasty (PTA) and stenting of the stenotic lesion in the subclavian or axillary artery is performed percutaneously. The open procedures include bypasses from the subclavian artery, transposition of the subclavian artery, arterioplasty and thrombendarterectomies (Table 1).

Since chronic ischaemia of the upper extremity is relatively rare, and only a few small studies are published on the results after revascularisation, we found it of interest to present this large population-based registry-study of patients treated for chronic ischaemia of the upper limb [1, 2].

MATERIAL AND METHODS

Since 1993, all vascular procedures performed in Denmark have been recorded prospectively in the Danish Vascular Registry including demographic data, indication for surgery, co-morbidity, and details about the surgical procedure, in-hospital complications and follow-up. The registry has previously been proven to have a high degree of completeness and accuracy [3]. The Registry is linked to the Danish National Patient Registry through a unique individual identity number, which allows for 100% follow-up on mortality for Danish citizens.

Patients were included in the period from January

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 TABLE 1

Type of open and endovascular procedure for chronic ischaemia of the upper limb, 1993-2011.

Procedure	n	%
<i>Endovascular procedure</i>		
PTA of the subclavian artery	217	93
PTA of the brachiocephalic trunk	16	7
Total	233	
<i>Open surgery</i>		
Thrombendarterectomy	12	5
Subclavian bypass	180	82
Subclavian transposition	25	11
Arterioplasty	3	1
Total	220	

PTA = percutaneous transluminal angioplasty.

1993 to December 2011. The selection was based on specific procedure codes according to the Nordic classification of operations (NOMESCO) [4] (Figure 1), and descriptive statistics were used to present the findings. In the inclusion period, a total of 101,725 primary arterial vascular procedures were recorded of which 74,375 cases were open arterial surgery and 27,350 PTAs. Of these, a total of 453 (0.4%) procedures were performed for chronic occlusive arterial disease in the proximal arteries of the upper limb; 233 procedures were endovascular and 220 were by open surgery (Figure 1). An analysis of the rare occasions of chronic ischaemia due to peripheral occlusions in the extremity lies beyond the scope of the presents analysis. The distribution of procedure types is presented in Table 1, and the patient demographics and indications for open and endovascular procedures are presented in Table 2.

Trial registration: not relevant.

RESULTS

Open reconstructions

Two patients died within 30 days which is equivalent to an early mortality rate of 0.9%. Six (2.7%) reconstructions occluded before discharge. Complications were observed in 41 patients (19%). A total of 21 (10%) had wound complications (haematoma or lymphoedema), while infections were observed in two (1%) patients; one infection was deep and one was superficial. Surgical complications occurred in eight patients (4%) including two with nerve damage. General complications were observed in 14 patients (6%) and were predominantly cardiac (five), pulmonary (six) and stroke (two) related. The median admission time was four days (interquartile range 2-6 days). Half of the patients (117, 53%) were followed for one year, and of these 112 (96%) reconstruc-

tions were reported to have been open, whereas five were occluded and one was amputated with open reconstruction. At follow-up, 74 (70%) had no symptoms, 14 (13%) had exercise-induced pain and one (1%) had critical ischaemia with gangrene.

Endovascular reconstructions

There were six deaths within the first 30 days which is equivalent to an early mortality rate of 2.6%. Four (2%) reconstructions occluded before discharge. Complications were observed for 23 (10%) patients. Wound complications (haematomas) were present for seven (3%) patients, and 4 (2%) had surgical complications (one nerve damage). General complications were observed in 13 patients (6%) which were divided among cardiac (three) pulmonary (one), stroke (three) and transient ischaemic attack (TIA) (four) complications. Median hospitalisation was one day (interquartile range 1-1, range 0-22 days). Half of the patients (126, 54%) were followed for one year, 122 (97%) of the reconstructions were open, whereas four were occluded and one was amputated with open reconstruction. At follow-up, 90 (74%) had no symptoms, 12 (10%) had exercise-induced pain and two (2%) had rest pain.

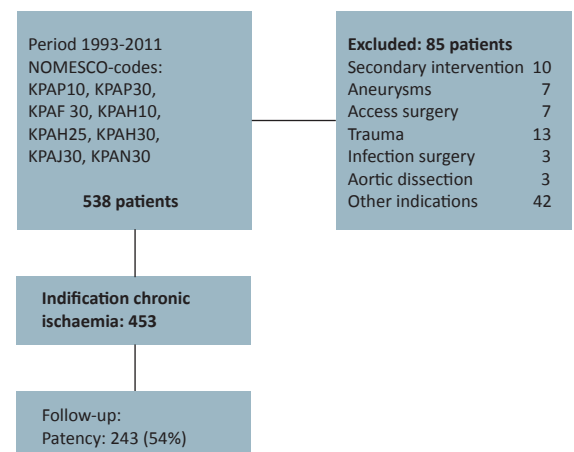
The one-year survival was 95% and there was no difference between the two groups.

DISCUSSION

This study is one of the largest published so far, although a limitation is that it only included patients undergoing treatment. Like in similar publications on this topic, the fate of the patients not offered treatment remains unknown.

 FIGURE 1

Flow diagram of the selected patients, 1993-2011.



NOMESCO = Nordic Medico-Statistical Committee.



TABLE 2

Patient demographics and co-morbidities.

	Open procedure	Endovascular procedure	Total
Age, yrs, mean (range)	58 (23-92)	59 (29-88)	58 (23-92)
<i>Gender, n (%)</i>			
Women	151 (68)	160 (69)	311 (69)
Men	69 (31)	73 (31)	142 (31)
<i>Smoking, n (%)</i>			
Current	131 (60)	144 (62)	275 (61)
Former	43 (20)	41 (18)	84 (19)
Never	34 (15)	32 (14)	66 (15)
Unknown	12 (5)	16 (7)	28 (6)
<i>Diabetes, n (%)</i>			
Yes	7 (3)	19 (8)	26 (6)
No	205 (93)	203 (87)	408 (90)
Unknown	8 (4)	11 (5)	19 (4)
<i>Hypertension, n (%)</i>			
Yes	61 (28)	72 (31)	133 (29)
No	150 (68)	151 (65)	301 (66)
Unknown	9 (4)	10 (4)	19 (4)
<i>Cardiac disease, n (%)</i>			
Yes	44 (20)	43 (18)	87 (19)
No	166 (75)	180 (77)	346 (76)
Unknown	10 (5)	10 (4)	20 (4)
<i>Pulmonary disease, n (%)</i>			
Yes	32 (15)	32 (14)	64 (14)
No	178 (81)	192 (82)	370 (82)
Unknown	10 (5)	9 (4)	19 (4)
<i>Indication, n (%)</i>			
Chronic ischaemia:			
Exercise-induced pain	108 (71)	156 (82)	264 (77)
Rest pain	32 (21)	17 (9)	49 (14)
Tissue loss	12 (8)	18 (9)	30 (9)
Total	153 (70)	191 (82)	344 (76)
Acute in chronic ischaemia			
Neurological	41 (19)	32 (14)	73 (16)
TOS	23 (10)	9 (4)	32 (7)
TOS	3 (1)	1 (0)	4 (1)

TOS = thoracic outlet syndrome.

Acceptable treatment results for chronic ischaemia of the upper limb can be obtained both by open surgery and by endovascular techniques even if both are rare procedures in the vascular department.

In the Danish cohort of arterial procedures, treatment for chronic ischaemia of the upper limb accounts for only 0.4% of the procedures, which is very low compared with the average of 4% reported in the literature [2, 5]. This difference may partly be explained by differences in selection criteria; viz. in the present study, acute and trauma procedures were excluded.

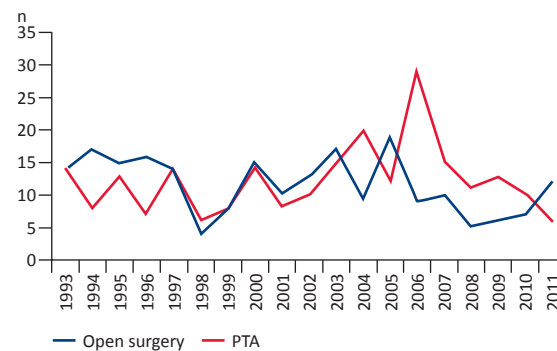
In contrast to the general shift in vascular surgery from open surgery towards endovascular procedures, we saw no such trend for this treatment.

In our material, only a single department had a transient shift in 2006; otherwise, the activity was char-



FIGURE 2

Annual number of open and endovascular procedures of the upper limb for chronic ischaemia 1993-2011. The peak in 2006 was not caused by changed practice on a single centre or changed recommendations.



PTA = percutaneously transluminal angioplasty.

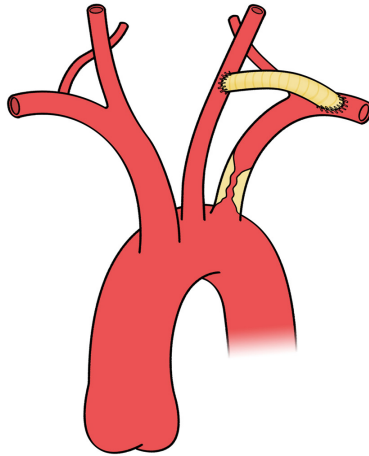
acterised by random variation over the observation period (Figure 2).

Our material consisted only of treatment of chronic proximal atherosclerotic lesions. Exercise-induced pain was by far the most common indication for both treatment modalities. Critical ischaemia (rest pain or gangrene) had almost twice as high a prevalence in the open surgery group as in the endovascular group. It was also noticeable that symptoms of neurological embolic origin most often led to open surgery.

The complication rate in this study may seem high, but the registry records also include minor and transient complications. Stroke is the most serious complication and it is most common after intervention on the branches of the aortic arch. In this study, this risk was at the same level as reported by others; two patients had a stroke after a carotico-subclavian bypass, and three patients had a stroke after endovascular treatment (one right- and two left-sided) [6-10]. Furthermore, three (1%) endovascularly treated patients suffered from TIA. These complication rates equal those reported in the literature [11].

Unfortunately, information from the one-year follow-up was available only in half of the patients, which introduces the risk of bias from incomplete data. We tried to locate the patients who were lost to follow-up, but unsuccessfully. They were either dead by other causes or their patient charts had been destroyed because of obsolescence. For the patients who did attend follow-up, there was an excellent one-year patency rate, which was comparable to that reported in the literature [1, 2, 12]. Patency was evaluated clinically and supported by measurement of peripheral blood pressure; for 232 (57%) patients preoperatively and for 147 (60%) of the patients at the one-year follow-up. Other modal-

Carotico-subclavian bypass is one of the treatment options in proximal revascularisation of chronic ischaemia of the upper limb. Drawing by Andreas Erstling.



ities, e.g. ultrasound-duplex scan, were not registered. Over the past 20 years, only few studies have been published on upper limb ischaemia, and they all included a small number of patients. Despite the small sizes, they all report the same patient demography (mean age around 60 years, 70% women), the same risk factors (smoking and diabetes), low mortality rates and excellent patency rates (approximately 90% after one year) [1, 2, 5, 13-17].

CONCLUSION

Chronic ischaemia of the upper limb is rare, but the condition is an important and, in some cases, disabling condition. The diagnosis is easy to establish if the suspicion is raised, and good treatment options are available. This study confirms that treatment can be performed safely and with excellent patency, both by endovascular procedures and by open surgery.

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