NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of superficial venous arterialisation for chronic limb threatening ischaemia

Chronic limb threatening ischaemia happens when blocked arteries reduce the blood flow in the lower leg. Symptoms include pain and ulcers. In severe cases the leg tissue dies because of the lack of blood supply and there is a high risk of losing the limb. In this procedure, an artery in the lower leg is joined to a large vein to divert blood flow through the vein towards the foot, bypassing the blocked arteries. The valves inside the vein are removed (superficial venous arterialisation) and smaller veins are blocked off. The aim is to improve symptoms and preserve the affected limb by restoring blood flow.

Contents

Abbreviations

Word or phrase	Abbreviation
Critical limb ischaemia	CLI
Chronic limb threatening ischaemia	CLTI
Great saphenous vein	GSV

Introduction

The National Institute for Health and Care Excellence (NICE) prepared this interventional procedure overview to help members of the interventional procedures advisory committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and professional opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in September 2021 and updated in March 2022.

Procedure name

- Superficial venous arterialisation for chronic limb threatening ischaemia

Professional societies

- Vascular Society of Great Britain and Ireland
- European Society for Vascular Surgery
- British Society for Endovascular Therapy
- British Society for Interventional Radiology.

Description of the procedure

Indications and current treatment

CLTI, also known as CLI, is a severe blockage in the arteries of the lower extremities. It is an advanced stage of peripheral arterial disease. CLTI is

characterised by severely diminished circulation, ischaemic pain, ulceration, tissue loss or gangrene. It is associated with high amputation and mortality rates, and poor quality of life.

CLTI needs immediate treatment to re-establish blood flow to the affected area and to prevent major amputation. Treatment options include medications, endovascular interventions (such as angioplasty, stents, laser atherectomy and directional atherectomy) and surgical treatments (such as bypass). Management of CLTI is described in NICE's clinical guideline on peripheral arterial disease.

What the procedure involves

Preoperative investigation (such as angiography, arterial and venous duplex scan) is needed to assess the vascular system and its blood flow. During the operation, an arteriovenous fistula is created between the GSV and the appropriate patent artery. The GSV is then anastomosed end-to-side to the artery below the knee. Side branches of the GSV to the ankle level are ligated and valvulotomy is done.

This procedure arterialises the venous arch of the foot, with GSV maintained in situ and without compromising the existing collateral circulation. The aim is to improve symptoms and salvage the affected lower extremity.

Efficacy summary

Limb salvage

In a cohort study of 60 patients with CLTI who had superficial venous arterialisation or antiplatelet therapy (100 mg aspirin per day), the rate of limb salvage was statistically significantly higher in the superficial venous arterialisation group than the antiaggregation therapy group after a mean follow up of 6 months (83% compared with 13%, $p<0.001$; Djoric 2012).

In a cohort study of 36 patients with CLTI who had superficial venous arterialisation or conversative treatment (antiplatelet drugs), limb salvage was reported in 92% (11/12) of patients who had superficial venous arterialisation and 13% (3/24) of patients who had conservative treatment at a mean follow up of 5 months ($p<0.001$; Djoric 2011).

In a cohort study of 28 patients with CLTI who had superficial venous arterialisation or conservative treatment, the rates of limb salvage at 1, 3, 6 and 12 months were 86%, 64%, 57% and 57% in the venous arterialisation group and 71%, 71%, 54% and 54% in the conservative treatment group (Matzke 1999).

In a case series of 18 patients with CLTI, limb salvage was reported in 56% (10/18) of patients who had superficial venous arterialisations at a mean follow up of 23 months (Busato 2010).

Survival

In the cohort study of 60 patients, the survival rate was statistically significantly higher in the superficial venous arterialisation group than the antiplatelet therapy group after a mean follow up of 6 months (97% compared with 67%, $p<0.01$; Djoric 2012).

In the cohort study of 36 patients, the survival rate was statistically significantly higher in patients who had superficial venous arterialisation than patients who had conservative treatment at a mean follow up of 5 months (100% compared with 67%, $p=0.024$; Djoric 2011).

In the cohort study of 28 patients, the survival rates at 1, 3, 6 and 12 months were 100%, 92%, 92% and 92% in the superficial venous arterialisation group and 100%, 79%, 64% and 64% in the conservative treatment group (Matzke 1999).

In the case series of 18 patients, the survival rate was 83% at a mean follow up of 23 months, with an overall mortality rate of 17% (Busato 2010).

Pain relief

In the cohort study of 60 patients, pain relief was achieved in 83% of patients in the superficial venous arterialisation group and 7% of patients in the antiaggregation therapy group after a mean follow up of 6 months ($p<0.001$; Djoric 2012).

In the cohort study of 36 patients, pain relief was reported in 75% (9/12) of patients who had superficial venous arterialisation compared with 8% (2/24) of patients who had conservative treatment at a mean follow up of 5 months ($p<0.001$; Djoric 2011).

Wound or minor amputation healing

In the cohort study of 60 patients, wound healing was reported in 88% of patients in the superficial venous arterialisation group compared with 0% in the antiaggregation therapy group after a mean follow up of 6 months ($p<0.001$; Djoric 2012).

In the cohort study of 36 patients, there was a statistically significant difference in wound healing between the superficial venous arterialisation group and the

conservative treatment group at a mean follow up of 5 months (78% compared with 0%, p<0.001; Djoric 2011).

In the case series of 18 patients, healing of minor amputations was reported in 33% (6/18) of patients at a mean follow up of 23 months after superficial venous arterialisation (Busato 2010).

Major amputations

Major amputations were done in 39% (7/18) of patients at a mean follow up of 23 months after superficial venous arterialisation in the case series of 18 patients (Busato 2010). Of these 7 patients, 1 patient with diabetes and chronic renal failure died after developing septicaemia by ascending infection.

Safety summary

Late revascularisation

Late revascularisation was done in 4 patients in the superficial venous arterialisation group and 1 in the conservative treatment group in the cohort study of 28 patients (Matzke 1999). Of the 4 patients in the superficial venous arterialisation group, 1 had a successful revascularisation.

Graft thrombosis

Graft thrombosis was reported in 6 patients who had superficial venous arterialisation in the cohort study of 60 patients (Djoric 2012).

Graft thrombosis within 48 hours postoperatively was reported in 17% (2/12) of patients who had superficial venous arterialisation in the cohort study of 36 patients (Djoric 2011).

Bleeding or haematoma

Bleeding was reported in 2 patients who had superficial venous arterialisation in the cohort study of 60 patients (Djoric 2012).

Haematoma because of coagulopathy was reported in 1 patient who had superficial venous arterialisation in the cohort study of 36 patients (Djoric 2011).

Infection

Infection of operative incision was reported in 1 patient who had superficial venous arterialisation in the cohort study of 60 patients (Djoric 2012).

Wound infection was reported in 2 patients who had superficial venous arterialisation in the cohort study of 36 patients (Djoric 2011).

Swelling

Leg swelling was reported in 3 patients who had superficial venous arterialisation in the cohort study of 60 patients (Djoric 2012).

Swelling of the foot was reported in 2 patients who had superficial venous arterialisation in the cohort study of 36 patients (Djoric 2011).

Other complications

Pneumonia was reported in 1 patient who had superficial venous arterialisation in the cohort study of 60 patients (Djoric 2012). Pneumonia was described in 1 patient in the superficial venous arterialisation group in the cohort study of 36 patients (Djoric 2011).

Cardiac decompensation was reported in 2 patients who had superficial venous arterialisation in the cohort study of 60 patients (Djoric 2012). Of the 2 patients, 1 patient had a fatal outcome.

Anecdotal and theoretical adverse events

In addition to safety outcomes reported in the literature, professional experts are asked about anecdotal adverse events (events which they have heard about) and about theoretical adverse events (events which they think might possibly happen, even if they have never happened).

For this procedure, professional experts listed the following anecdotal and theoretical adverse events: peripheral embolisation, potentially steal syndrome and other adverse events that are similar to a hybrid vascular procedure, involving interventional radiology and vascular surgery.

The evidence assessed

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to superficial venous arterialisation for chronic limb threatening ischaemia. The following databases were searched, covering the period from their start to 29 March 2022: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the internet were also searched (see the literature

search strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The inclusion criteria were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients with CLTI.
Intervention/test	Superficial venous arterialisation and selective venous occlusion.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the IP overview

This IP overview is based on 142 patients from 3 cohort studies (Djoric 2011, 2012; Matzke 1999) and 1 case series (Busato 2010).

Other studies that were considered to be relevant to the procedure but were not included in the main summary of the key evidence are listed in the appendix.

Summary of key evidence on superficial venous arterialisation for chronic limb threatening ischaemia

Study 1 Djoric P (2012)

Study details

Study type	Cohort study (prospective)
Country	Serbia (single centre)
Recruitment period	2009 to 2011
Study population and number	n=60 (distal venous arterialisation, n=30; antiaggregation therapy [100 mg aspirin per day], n=30) Patients with CLI
Age and sex	Distal venous arterialisation: mean 65.37 years; 70% (21/30) male Antiaggregation therapy: mean 65.93 years; 57% (17/30) male
Patient selection criteria	Inclusion criteria for distal venous arterialisation: patients with CLI but without the option for arterial reconstruction because of peripheral arterial occlusive disease with patent aortoiliac segment. Exclusion criteria for distal venous arterialisation: insufficient deep venous system and unsuitable GSV; extensive infective and/or necrotic process up to the metatarsal level; and poor prognosis of the patients.
Technique	Distal venous arterialisation was done under regional anaesthesia with prophylactic antibiotics and intravenous heparin administration. After dissection of the median marginal vein of the foot and GSV, all tributaries were ligated caudally up to the ankle and laterotterminal anastomosis was created between the GSV and the inflow artery. Valvulotomy was done.
Follow up	Distal venous arterialisation: mean 6.13±4.32 months Antiaggregation therapy: mean 6.74±0.5 months
Conflict of interest/source of funding	This work was supported by the grant No. 175043 from the Ministry of Science and Technical Development of the Republic of Serbia.

Analysis

Study design issues: This prospective randomised study assessed clinical efficiency and possible impact of distal venous arterialisation tissue damage by estimating oxidative status of patients with CLI treated with this procedure. The clinical outcomes included survival, limb salvage, pain relief and wound healing.

Of the included patients, 30 suitable patients were chosen for treatment with distal venous arterialisation. The remaining 30 patients were treated with the antiaggregation therapy (100 mg aspirin per day). Randomisation

was done for sex, age, stage of disease, incidence of diabetes, hypertension, and smoking. All operations were done by a single surgeon.

Study population issues: Of the 60 patients, most had gangrene or unhealed painful ulceration of the foot. They had significant accompanying comorbidity. In both groups, one to two thirds of the patients had at least 1 of the following risk factors: diabetes, hypertension and smoking. Around 30% to 40% of the patients had carotid and/or coronary artery disease. There were no statistically significant differences in age, sex, stage of disease, and comorbidity between groups. In the distal venous arterialisation group, reverse vein bypass graft with the position of a distal anastomosis on the junction of the dorsal venous arch and the superficial vein of the thumb was used in 6 patients. In this way arterial blood flow was made possible in 2 directions.

Key efficacy findings

Number of patients analysed: 60

Clinical outcomes after distal venous arterialisation and antiaggregation therapy

	Distal venous arterialisation (n=30)	Antiaggregation therapy (n=30)	P value
Survival	97%	67%	<0.01
Limb salvage	83%	13%	<0.001
Pain relief	83%	7%	<0.001
Wound healing	88%	0%	<0.001

In 3 patients with a patent graft the gangrene process was not stopped, which needed an urgent high amputation of the extremities.

Preoperatively, there were no statistically significant differences in values of digital systolic pressure (30.67±7.512 mm Hg compared with 31.40±5.917 mm Hg, p=0.676) and digital-brachial index between the distal venous arterialisation and antiaggregation therapy groups (0.233±0.060 compared with 0.225±0.051, p=0.582). After distal venous arterialisation, a significant increase of digital systolic pressure values at 68.4±16.21 mm Hg (p<0.001) and digital-brachial index at 0.487±0.149 (p<0.001) was found.

Lactate level:

- Immediately before procedure: 2.43±0.49 mmol/l
- 10 minutes after procedure: 1.143±0.329 mmol/l
- P<0.001

Key safety findings

General complications of distal venous arterialisation:

- Pneumonia: n=1
- Cardiac decompensation: n=2 (with the fatal outcome in 1 patient)

Surgical complications of distal venous arterialisation (1 patient had simultaneous bleeding and early graft thrombosis):

- Infection of operative incision: n=1
- Bleeding: n=2
- Graft thrombosis: n=6
- Leg swelling: n=3

Most of the patients in the antiaggregation therapy group, 8 out of 10, died of septic complications of the foot gangrene.

Study 2 Djoric P (2011)

Study details

Study type	Cohort study (prospective)
Country	Serbia (single centre)
Recruitment period	2009
Study population and number	n=36 (distal venous arterialisation, n=12; conservative treatment [antiplatelet drugs], n=24) patients with CLI
Age and sex	Distal venous arterialisation: mean 64.3 years; 59% (7/12) male Control: mean 67.1 years; 54% (13/24) male
Patient selection criteria	Inclusion criteria for distal venous arterialisation: absence of any possibility for direct revascularisation as a result of extensive occlusive disease of crural and pedal arteries; sufficient deep venous system and usable GSV as a graft for in situ bypass surgery according to duplex scanning; localised infective and/or necrotic process up to the metatarsal level; and a satisfactory general patient condition.
Technique	Distal venous arterialisation was done under spinal or epidural anaesthesia with prophylactic antibiotics. After exposing the median marginal vein of the foot and GSV cranially up to the suitable site for the anastomosis, all tributaries of the GSV were ligated caudally up to the ankle and leteroterminal anastomosis was created between GSV and the appropriate inflow artery. After intravenous heparin administration, valvulotomy was done.
Follow up	Distal venous arterialisation: mean 4.8±3.9 months (range 1 to 14 months) Conservative treatment: mean 4.9±2.4 months (range 1 to 9 months)
Conflict of interest/source of funding	Not reported

Analysis

Study design issues: This prospective study estimated the validity of distal venous arterialisation as a limb salvage procedure. The primary outcomes included limb salvage, patient survival and clinical improvement as pain relief and wound healing. The secondary outcomes included early metabolic (serum lactate level) and haemodynamic changes (toe systolic pressure measurements) after reverse limb revascularisation. All procedures were done by a single surgeon.

Study population issues: At baseline, the 2 groups were well matched for age, sex, stage of disease, incidence of diabetes, hypertension and smoking. There were no statistically significant differences between groups in serum lip level, obesity and several comorbidity conditions such as coronary and carotid artery disease, renal failure and chronic pulmonary obstructive disease.

Key efficacy findings

Number of patients analysed: 36

The outcome of the treatment in patients with distal venous arterialisation compared with conservative treatment

Group	Distal venous arterialisation (n=12)	Conservative treatment (n=24)	P value
Survival	100% (12/12)	67% (16/24)	0.024
Limb salvage	92% (11/12)	13% (3/24)	0.000
Pain relief	75% (9/12)	8% (2/24)	0.000
Wound healing	78% (7/9)	0% (0/12)	0.000

Distal venous arterialisation group (n=12)

- Minor amputations: n=6
- Graft patency: 83.3% (n=10)
- Graft thromboses within 48 hours: 16.7% (n=2)

Haemodynamic parameters such as systolic digital pressure and digitobrachial systolic pressure index were increased after revascularisation using Student t test ($p<0.001$).

Key safety findings

Distal venous arterialisation group:

- Intrahospital morbidity: 50% (including local surgical and general complications)
    - Wound infection: n=2 (infection was treated with antibiotics)
    - Haematoma: n=1 as a result of coagulopathy (haematoma evacuation with the swelling subsiding in 2 months)
    - Swelling of the foot: n=2
    - Pneumonia: n=1
- Mortality: 0%

Conservative treatment group: mortality: 33.3% (n=8)

Of the 8 patients, 5 died from septic complications such as gangrene of the foot, and 2 died from myocardial infarction and pulmonary carcinoma.

Mortality between groups was statistically significantly different ($p<0.05$)

Study 3 Matzke J (1999)

Study details

Study type	Cohort study (retrospective)
Country	Finland (2 centres)
Recruitment period	1991 to 1995
Study population and number	n=28 (venous arterialisation, n=14; conservative treatment, n=14) Patients with CLI
Age and sex	Venous arterialisation: mean 74 years: sex not reported Conservative treatment: 72 years; sex not reported
Patient selection criteria	Inclusion criteria for the venous arterialisation group: patients had CLI according to the Fontaine classification and were not suitable for a standard vascular bypass operation because of narrow or occluded distal arteries. Inclusion criteria for the conservative treatment group: patients were selected to match the patients in the arterialisation group by age (with a range of 10 years), sex, diabetes and Fontaine classification; were considered not to be suitable for a bypass reconstruction because of technical reasons or an increased operative risk.
Technique	Venous arterialisation: the GSV was connected to the common or proximal superficial femoral artery and all venous side branches down to the ankle were ligated. The venous valves were destroyed from an incision at ankle level, proximal ones retrogradely and distal ones antegradely.
Follow up	12 months
Conflict of interest/source of funding	Not reported

Analysis:

Study design issues: This retrospective cohort study assessed the outcomes of a series of patients who had arterialisation and compared them with patients who had conservative treatment. All arterialisations were done by the same vascular surgeon.

Study population issues: Between the 2 groups, a match according to the match criteria was found for every patient except 1, whose age differed more than 10 years. In 1 patient femorodistal reconstruction was attempted prior to arterialisation.

Other issues: Because of the small sample, a type 2 statistically error may always bias the results in a comparison of 2 groups.

Key efficacy findings

Number of patients analysed: 28

Clinical outcomes

Clinical outcome	Arterialisation	Conservative treatment
Limb salvage		
1 month	86%	71%
3 months	64%	71%
6 months	57%	54%
12 months	57%	54%
Survival		
1 month	100%	100%
3 months	92%	79%
6 months	92%	64%
12 months	92%	64%

No difference in terms of leg salvage times could be detected.

According to the analysis with the Cox regression model, the survival times differed at the p=0.07 level. However, the Bonferroni-corrected p value was 0.14.

50% of the amputations in the arterialisation group were done with a patent graft.

Key safety findings

Revascularisation: n=5 (4 patients in the arterialisation group and 1 in the conservative treatment group)

Study 4 Busato CR (2010)

Study details

Study type	Case series (retrospective)
Country	Brazil (single centre)
Recruitment period	Not reported
Study population and number	n=18 patients with CLI without arterial runoff
Age and sex	Not reported
Patient selection criteria	Not reported
Technique	After angiography and arterial duplex scans were done, an arteriovenous fistula was created and the GSV was then anastomosed end-to-side to the best donor vein. The arterial flow into the venous system progressed through the vein whose valves were destroyed using valvulotomy. All side branches of the GSV were ligated from the arterial anastomosis until the anterior perforating vein of the malleolus.
Follow up	Mean 695.6 days (23 months; range 213 to 1,006 days)
Conflict of interest/source of funding	None

Analysis

Study design issues: This study described the technique and presented the results obtained after arterialisations of the venous arch of the foot with GSV maintained in situ.

Study population issues: Of the 18 patients, 11 had atherosclerosis obliterans, 6 had thromboangiitis obliterans and 1 had late presentation of popliteal artery aneurysm with distal thrombosis. Among the 11 patients with atherosclerosis obliterans, 6 had diabetes mellitus and, out of these, 2 had renal failure and depended on haemodialysis.

Key efficacy findings

Number of patients analysed: 18

Limb salvage: 55.6% (n=10, including 5 patients with atherosclerosis obliterans and 5 patients with thromboangiitis obliterans)

Healing of minor amputations: 33.3% (n=6, including 2 transmetatarsial, 2 finger and 2 phalanx amputations)

Major amputations: 38.9% (n=7, including 3 above the knee and 4 below the knee)

Of the 7 patients, 5 had atherosclerosis obliterans, 1 had thromboangiitis obliterans and 1 had popliteal artery aneurysm with distal thrombosis.

Key safety findings

Overall mortality: 17% (n=3)

Of the 3 patients, 1 patient with diabetes mellitus and chronic renal failure died (5.5%) after developing septicaemia by ascending infection, and 2 patients with atherosclerosis obliterans died because of comorbidities related to patent graft.

Validity and generalisability of the studies

- Studies were conducted in Serbia (Djoric 2011, 2012), Finland (Matzke 1999) and Brazil (Busato 2010). There was no data related to the UK context.
- The total sample was small (n=142) and the mean follow-up durations ranged from 5 to 23 months. Therefore, studies in larger cohorts with longer follow up were lacking.
- The population was patients with CLTI who were considered unsuitable for a standard vascular bypass operation or arterial revascularisation.
- There might be some patient overlap between studies (Djoric 2011, 2012).
- There was variation in the surgical technique relating to such as its details and steps.
- Three cohort studies compared the clinical outcomes of superficial venous arterialisation and selective venous occlusion with conservative treatment. Therefore, studies comparing this surgical technique with bypass surgery or endovascular treatment might be needed.

Existing assessments of this procedure

There were no published assessments from other organisations identified at the time of the literature search.

Related NICE guidance

Below is a list of NICE guidance related to this procedure.

NICE guidelines

- Peripheral arterial disease: diagnosis and management. NICE Clinical guideline 147 (2012; last updated: 11 December 2020). Available from https://www.nice.org.uk/guidance/cg147

- Diabetic foot problems: prevention and management. NICE guideline 19 (2015; last updated: 11 October 2019). Available from https://www.nice.org.uk/guidance/ng19

Additional information considered by IPAC

Professional experts' opinions

Expert advice was sought from consultants who have been nominated or ratified by their professional Society or Royal College. The advice received is their individual opinion and is not intended to represent the view of the society. The advice provided by professional experts, in the form of the completed questionnaires, is normally published in full on the NICE website during public consultation, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

Three professional expert questionnaires for superficial venous arterialisation for chronic limb threatening ischaemia were submitted and can be found on the NICE website.

Patient commentators' opinions

NICE's Public Involvement Programme was unable to gather patient commentary for this procedure.

References

1. Djoric P, Zeleskov-Djoric J, Stanisavljevic DM et al. (2012) Distal venous arterialization and reperfusion injury: focus on oxidative status. European surgical research. Europaische chirurgische Forschung. Recherches chirurgicales europeennes 48(4): 200–7
2. Djoric P (2011) Early individual experience with distal venous arterialization as a lower limb salvage procedure. American surgeon 77(6): 726–30
3. Matzke S, Pitkanen J and Lepantalo M (1999) Does saphenous vein arterialisation prevent major amputation in critical leg ischaemic? A comparative study. The Journal of Cardiovascular Surgery 40(6): 845–7
4. Busato CR, Utrabo CAL, Gomes RZ et al. (2010) The great saphenous vein in situ for the arterialization of the venous arch of the foot. J Vasc Bras 9

Literature search strategy

Databases	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	29/03/2022	Issue 3 of 12, March 2022
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	29/03/2022	Issue 2 of 12, February 2022
International HTA database (INAHTA)	29/03/2022	-
MEDLINE (Ovid)	29/03/2022	1946 to 28 March 2022
MEDLINE In-Process (Ovid)	29/03/2022	1946 to 28 March 2022
MEDLINE Epubs ahead of print (Ovid)	29/03/2022	28 March 2022
EMBASE (Ovid)	29/03/2022	1974 to 28 March 2022
EMBASE Conference (Ovid)	29/03/2022	1974 to 28 March 2022

Trial sources searched

- Clinicaltrials.gov
- ISRCTN
- WHO International Clinical Trials Registry

Websites searched

- National Institute for Health and Care Excellence (NICE)
- NHS England
- Food and Drug Administration (FDA) – MAUDE database
- Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP – S)
- Australia and New Zealand Horizon Scanning Network (ANZHSN)
- General internet search

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

Literature search strategy

Number	Search term
1	Peripheral Arterial Disease/
2	Arteriosclerosis Obliterans/
3	Thromboangiitis Obliterans/

4	((peripheral adj4 arterial adj4 diseas*) or (arterioscler* adj4 obliterans) or (thromboang* adj4 obliterans) or buerger*).tw.
5	(CLI or CLTI).tw.
6	exp Ischemia/ and Lower Extremity/
7	(Critical limb adj4 isch*).tw.
8	(desert adj4 foot).tw.
9	Aneurysm/ and Popliteal Artery/
10	("Popliteal arter* aneurysm*" and thrombos* and distal).tw.
11	or/1-10
12	((venous or vein*) adj4 arteriali?ation).tw.
13	((venous or vein*) adj4 occlusion).tw.
14	Arteriovenous Fistula/
15	(Arterio-venous fistula or arteriovenous fistula or AVF).tw.
16	(("In situ" adj4 reverse* adj4 arterial*) or ISRA).tw.
17	(("In situ" or reverse*) adj4 (GSV or great* saphenous vein*)).tw.
18	Saphenous Vein/
19	("In situ" or reverse*).tw.
20	18 and 19
21	(Limb* adj4 (sparing or spare or save or saving or salvage) adj4 (technique* or method* or procedure*)).tw.
22	exp vascular surgical procedures/ or exp endovascular procedures/
23	(hybrid adj4 (technique* or method* or procedure*)).tw.
24	22 and 23
25	(hybrid adj4 (vascular or endovascular) adj4 (technique* or method* or procedure*)).tw.
26	12 or 13 or 14 or 15 or 16 or 17 or 20 or 21 or 24 or 25
27	11 and 26
28	(Selective adj4 (arterio-venous or arteriovenous) adj4 endoluminal switch).tw.
29	Animals/ not Humans/

30	27 or 28
31	30 not 29
32	limit 31 to english language

Appendix

The following table outlines the studies that are considered potentially relevant to the IP overview but were not included in the summary of the key evidence. It is by no means an exhaustive list of potentially relevant studies.

Additional papers identified

Article	Number of patients/ follow up	Direction of conclusions	Reasons for non-inclusion in summary of key evidence section
Houlind K (2020) Surgical revascularization and reconstruction procedures in diabetic foot ulceration. Diabetes/metabolism research and reviews 36(S1): e3256	Review	Open surgical techniques in addition to more routinely performed procedures such as thrombendartecectomies and bypass to femoropopliteal or crural vessels, have acceptable results by increasing limb salvage rates in patients for whom amputation would otherwise have been the only option. These techniques are probably underutilized in many centres. Most of them do not require much extra in terms of facilities or instruments and they should be incorporated into routine practice in centres which manage patients with complex diabetic foot pathology.	Review article
Lichtenberg M, Schreve MA, Ferraresi R et al. (2018) Surgical and endovascular venous arterialization for treatment of critical limb ischaemia. VASA. Zeitschrift fur	Review	Chronic CLI continues to be a challenge. Venous arterialisation may be a viable alternative for the preservation of limbs but the technique is not fully developed yet. Forward pressure seems to be a key factor. The percutaneous approach helps to reduce	Review article

Gefasskrankheiten 47(1): 17–22		surgical stress in this vulnerable patient group.	
Lu XW, Idu MM, Ubbink DT et al. (2006) Meta-analysis of the clinical effectiveness of venous arterialization for salvage of critically ischaemic limbs. European journal of vascular and endovascular surgery: the official journal of the European Society for Vascular Surgery 31(5): 493–9	Meta-analysis n=228 (7 studies)	On the basis of limited evidence, venous arterialisation may be considered as a viable alternative before major amputation is undertaken in patients with 'inoperable' chronic critical leg ischaemia.	Outcomes for this procedure were not reported separately and the relevant article (English language) was included in the key evidence.
Schreve MA, Vos CG, Vahl AC et al. (2017) Venous arterialisation for salvage of critically ischaemic limbs: a systematic review and meta-analysis. European journal of vascular and endovascular surgery: the official journal of the European Society for Vascular Surgery 53(3): 387–402	Systematic review and meta-analysis n=768 (15 studies)	In this systematic review on venous arterialisation in patients with non-reconstructable CLI, the pooled proportion of limb salvage at 12 months was 75%. Venous arterialisation could be a valuable treatment option in patients facing amputation of the affected limb; however, the current evidence is of low quality.	Outcomes for this procedure were not reported separately and 4 studies that were relevant to this procedure were included in the key evidence.
Schreve MA, Unlu C, Kum S et al. (2017) Surgical and endovascular venous arterialization: ready to take the "desert" by storm? The Journal of cardiovascular surgery 58(3): 402–8	Review	Venous arterialisation may be a viable alternative to preserving limbs. The percutaneous approach shows promise and is a minimally invasive technique to reduce surgical stress in patients with CLI.	Review article

Sheil AGR (1977) Treatment of critical ischaemia of the lower limb by venous arterialisation: an interim report. British journal of surgery 64(3): 197–9	Case series n=6	Although as a result of the procedure amputation was avoided in 3 out of 6 patients, the place of the method in the treatment of critical ischaemia of the lower limb remains dubious. Further investigation and modification of the method are planned.	Small sample