



## Original article

# Lymphoscintigraphy study of oedema after femoropopliteal segment surgery

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## A B S T R A C T

**Introduction:** Post-surgical oedema of the femoropopliteal segment is a frequent complication, unrelated to the severity of the previous symptoms or changes in subsequent distal arterial pressure. The aim of the study is to assess whether the oedema present in femoropopliteal bypass patients is of lymphatic origin, and the possible influence of the prosthesis and the type of intervention used.

**Patients and methods:** An analytical, observational and case-control study of 30 patients who had a femoropopliteal bypass. Isotopic lymphoscintigraphy of the superficial and deep lymphatic system was performed on both limbs in all patients selected for the study.

**Results:** The saphenous vein was used in 19 patients and PTFE in 11. The patients were divided into controls, 15 without oedema, and cases, 15 with oedema. Surgery technique: 9 reconstructions of the popliteal portion (1st p.p.), 18 third popliteal portion (3rd p.p.), and 3 distal branches.

**Scintigraphy findings:** Asymmetric lymphatic drainage between the 2 limbs was observed in the all 30 examinations, except 1 case (which did not have oedema). There was no lymphatic drainage in 5 cases (one developed oedema). Cases with controls and patients with an autologous or synthetic graft, as well as shunts above and below the knee, were compared. The only statistical difference obtained was that the latter developed oedema more often than those performed close to the knee.

**Conclusions:** Therefore, the scintigraphy findings did not point to lymphatic damage as a cause of post-femoropopliteal surgery oedema. The material used did not appear to influence this. The below-knee shunts suffered more oedema than those above the knee.

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## Estudio mediante linfogammagrafía isotópica del edema postquirúrgico tras cirugía del sector fémoro-poplíteo

### R E S U M E N

#### Palabras clave:

Bypass femoropoplíteo

Edema

Linfogammagrafía isotópica

**Introducción:** El edema postcirugía del sector femoropoplíteo es una complicación frecuente, no relacionada con la gravedad de los síntomas previos ni con los cambios en la PA distal posterior. El objetivo del estudio es evaluar si el edema observado en los pacientes intervenidos de bypass femoropoplíteo es de causa linfática, y la posible influencia del tipo de prótesis utilizada y del tipo de intervención.

**Pacientes y métodos:** Estudio analítico observacional de casos control con 30 pacientes intervenidos de bypass femoropoplíteo. Se ha realizado linfogammagrafía isotópica del sistema linfático superficial y profundo de ambas extremidades en todos los pacientes seleccionados para el estudio.

**Resultados:** Se utilizó vena safena en 19 pacientes y PTFE en 11. Quince pacientes fueron controles (sin edema) y 15 casos (con edema). Tipo de cirugía: 9 reconstrucciones a primera porción de poplíteo (1.<sup>a</sup> p.p.), 18 a tercera porción de poplíteo (3.<sup>a</sup> p.p.) y 3 a ramas distales.

**Hallazgos gammagráficos:** en las 30 exploraciones se observó asimetría del drenaje linfático entre las 2 extremidades, excepto en 1 caso (que no presentó edema). En 5 no había drenaje linfático (uno desarrolló edema). Se compararon casos con controles y pacientes con injerto autólogo y sintético, así como derivaciones por encima y por debajo de la rodilla. La única significación estadística que se obtuvo fue que estos últimos desarrollaron edema con mayor frecuencia que los practicados proximalmente a la rodilla.

**Conclusión:** Por tanto los hallazgos linfogammagráficos no apuntan al daño linfático como causa del edema postcirugía femoropoplíteo. Tampoco el material utilizado parece tener influencia. Las derivaciones infrageniculares sufren más edema que las suprageniculares.

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## Introduction

Peripheral oedema is a common complication following arterial reconstruction by femoropopliteal bypass. As well as being a frequent cause of morbidity, the presence of this condition does not appear to be connected to the severity of preoperative symptoms,<sup>1</sup> nor with changes observed in distal BP. It appears not only in patients who have received treatment using synthetic materials, but also in those using autologous veins. The causes of this phenomenon have not been studied extensively, and few bibliographic references exist on the topic. Although the general idea is that the principal cause is lymphatic damage<sup>2-5</sup> based on the absence of other aetiologies and on a few studies. However it is noticeable that in other surgeries, such as in the aortoiliac sector, that also involve an inguinal dissection, oedemas are a lot less common.

The objective of this study was to evaluate whether or not the oedema observed in patients who had received femoropopliteal bypass was based on lymphatic causes, and to determine if an association exists between the type of prosthesis used (synthetic or autologous) and the appearance of the oedema, as well as the influence of the type of surgical procedure.

## Patients and methods

We performed an analytical observational case-control study with patients operated on in the femoropopliteal sector. The study included 29 patients, one of which was operated on bilaterally (n=30).

**Inclusion criteria:** patients operated on using a bypass from the common femoral to the first or third portion of the popliteal or distal branches, due to sub-acute ischemia (1), chronic ischemia (26), or aneurism (3), who had accepted to be part of the study by signing an informed consent.

**Exclusion criteria:** previous surgery in either of the two lower limbs, previous oedema, pre or postoperative infection, postoperative deep vein thrombosis.

On the medical chart, we took note of: age, pathological background, type of surgery, type of material used, alterations in lab results, type and level of oedema when present and the results from the isotopic lymphoscintigraphy.

We performed a venous Doppler-Ultrasound study on all patients included in the study, except for those in which the examination suggested a deep vein thrombosis.

Oedema was measured between the second and fifth day after the operation at three levels: malleolus, calf, and thigh. These measurements were compared with the other limb.

The patient was considered to have an oedema when the circumference in at least one of the three segments was over two centimetres greater than the contralateral measurement. An isotopic lymphoscintigraphy (IL) was performed on the superficial and deep lymphatic systems of all patients that participated in this study.

The procedure consisted of injecting 74 MBq of  $^{99m}\text{Tc}$ -nanocoll (albumin nanocolloid) through a subdermal interstitial puncture in the first and second interdigital spaces and in the posterior region of the tibial malleolus in both limbs.

Consecutive measurements were then taken with posterior views of the popliteal region and anterior views of the inguocrural region at 10 and 30 min and 1 and 2 hrs post-injection. We evaluated any asymmetry, interruption or alterations in the velocity of lymph drainage in the operated limb compared to the contralateral extremity. We also evaluated the presence of stasis and/or variations in the number of lymph nodes in the operated limb.

For the statistical analysis we used the Chi-squared test for homogeneity and/or dependence between groups for qualitative variables, and Student's t-test for quantitative variables. Differences were considered to be statistically significant when  $P$  is  $<0.05$ .

29 patients were examined (23 male), with a mean age of 68 years (range: 46-89), one of which was operated on bilaterally ( $n=30$ ), 15 of which had developed oedema (test cases) and the rest ( $n=15$ ) were controls.

We detected no statistically significant differences in age between the two groups (Student's  $t$ ;  $P=.499$ ).

Autologous material was used in 19 patients (63%) and synthetic materials in 11 (37%).

## Results

The analysis of the groups produced the following results:

- 15 controls (no oedema): 11 autologous materials, 4 PTFE.
  - Surgery type: 7 bypasses at 1st portion of the popliteal, 7 bypasses at 3rd portion of the popliteal, 1 bypass at distal branches.
- 15 cases (with oedema): 8 autologous material, 7 PTFE.
  - Surgery type: 2 bypasses at 1st portion of the popliteal, 11 bypasses at 3rd portion of the popliteal, 2 bypasses at distal branches.

**Table 1 – Oedema based on type of surgery**

Type of surgery	No oedema	Oedema	Total
Bypass at 1 <sup>st</sup> p.p.	7	2	9
Bypass at 3 <sup>rd</sup> p.p. and distal branches	8	13	21
Total	15	15	30
			$P=.030$

p.p. indicates popliteal portion.

When evaluating oedema in terms of surgery type, we see that supragenicular reconstructions developed oedema in 2 of 9 cases, whereas infragenicular reconstructions produced oedema in 13 of 21 cases, a statistically significant difference ( $P=.030$ ) (Table 1).

When comparing results by material used for the bypass, patients receiving autologous veins had oedema in 8 of 19 cases, whereas PTFE use produced oedema in 7 of 11 patients. This difference was not statistically significant (Table 2).

## Lymphoscintigraphy findings (IL)

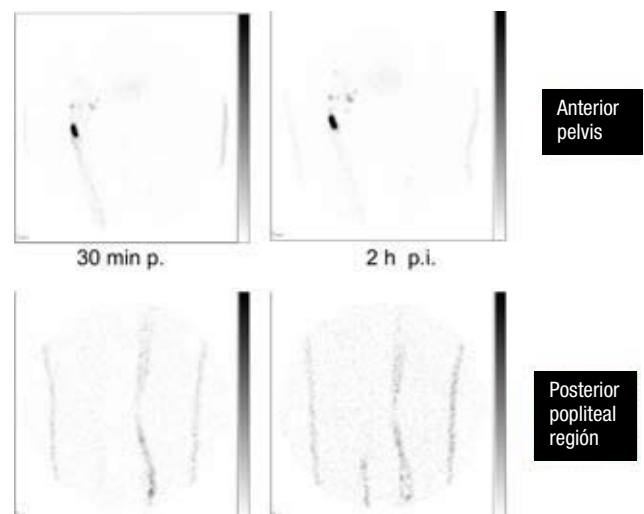
The lymphoscintigraphy was evaluated in only 29 patients, since one patient was operated on bilaterally meaning that comparison with the healthy limb was impossible. We observed asymmetry in lymphatic drainage in all but one patient, who had been operated on using PTFE and did not present oedema.

Lymph drainage was observed in all patients except for four that received autologous bypasses and one who had received a PTFE bypass, in which no drainage was observed (Figure 1). Two of these had not developed oedema (control patients with autologous bypasses).

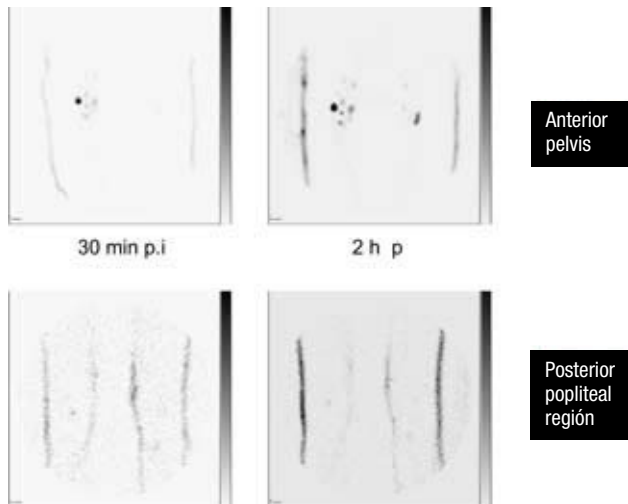
As such, we can consider the asymmetry of lymph drainage to be a global phenomenon. The evaluation of this asymmetry showed fewer nodes in the femoral-inguinal area

**Table 2 – Oedema based on material used**

	Type of material		
	Autologous	PTFE	Total
No oedema	11	4	15
Oedema	8	7	15
Total	19	11	30
			$P>0$ .



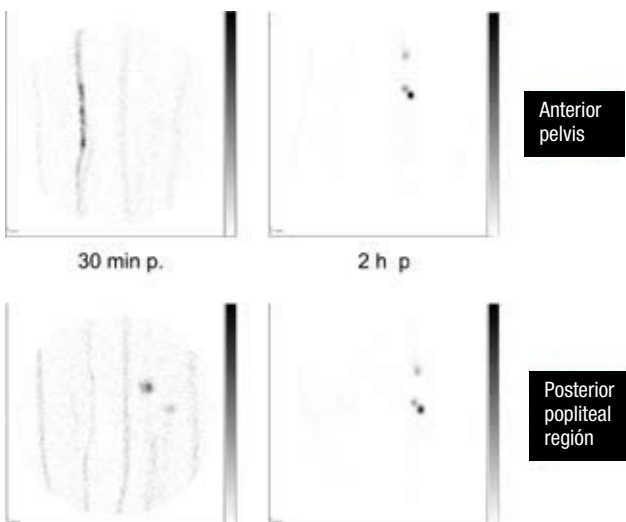
**Figure 1 – Lymphoscintigraphy showing no representation in the left leg.**



**Figure 2 – Lymphoscintigraphy showing fewer nodes in the left inguinal region.**

**Table 3 – Comparison between control and test cases evaluating lymph representation and the type of material used**

Lymphoscintigraphy	Oedema	Autologous	PTFE	Total
< No. of nodes	No	5	2	7
	Yes	4	4	8
	Total	9	6	15
>No. of nodes	No	3	1	4
	Yes	2	2	4
	Total	5	3	8
No representation	No	2	0	2
	Yes	2	1	3
	Total	4	1	5
Symmetry	No		1	1



**Figure 3 – Lymphoscintigraphy showing popliteal stasis in the right leg.**

**Table 4 – Comparison between control and test cases evaluating the presence or absence of popliteal stasis and the material used**

Lymphoscintigraphy	Oedema	Autologous	PTFE	Total
Stasis	No	6	2	8
	Yes	5	4	9
	Total	11	6	17
No stasis	No	4	2	6
	Yes	3	3	6
	Total	7	5	12

in 15 patients (51.7%) (Figure 2), 8 of which presented oedema and 7 not, whereas more nodes were found in 8 cases (27.6%), 4 of which were control cases and 4 test cases (Table 3).

We observed popliteal stasis in 17 of 29 patients (Figure 3). Nine of these had presented oedema and 8 were controls (Table 4). Given these similar results, the comparison of control and test cases produces no statistically significant differences in altered lymph drainage.

## Discussion

Oedema following reconstruction in the femoropopliteal sector is a relatively frequent complication that is not very predictable as it does not appear to have any relationship with the severity of preoperative ischemia.<sup>1,2</sup>

The most widely accepted theories are lesions to the lymph system during surgery and an inflammatory reaction in the case of reconstruction using synthetic materials. While the first theory has been defended by several studies,<sup>2-5</sup> we were unable to find any study that showed that the material used influenced the appearance of oedema. Among the proponents of the lymph theory, some controversy exists between those that assert that the type of incision is a determinant for avoiding lymph node damage<sup>2</sup> and those that give this factor no importance whatsoever.<sup>5</sup> Jacobs<sup>6</sup> believes that the appearance of oedema is mainly caused by compromised microcirculation before the operation. Lesions to the inguinal nodes could be put in doubt as the responsible factor for oedema, since some studies<sup>1,7</sup> have pointed out that after aortic and ileofemoral reconstructions, in which femoral dissections are also necessary, oedema is very rare when compared to operations in the femoropopliteal sector. This points to the type of surgery as the determining factor. Soong<sup>8</sup> advocates reducing the number of free radicals in order to avoid postoperative oedema but without studying what causes this.

In this study, we found a similar distribution of lymph alterations between control and test groups, indicating that lymph node lesions are not the cause of oedema. This is reinforced by taking into account that more lymph node lesions occurred in patients with vein grafts, probably due to the more extensive dissection required, whereas patients who received PTFE implants developed oedema more frequently.

Although these differences were not statistically significant, perhaps due to the relatively low sample size. The difference between reconstructions performed above and below the knee was statistically significant. Operations below the knee were more prone to develop oedema, which, in the absence of other possible factors, indicates that the type of procedure is the most important variable among those examined in this study.

As a result, we can affirm that the variables analysed such as the material used and preoperative lymph node lesions do not significantly influence the development of oedema in patients that receive surgery in the femoropopliteal sector.

The type of operation appears to be the most important factor in producing oedema, in the sense that distal reconstructions have a lower tendency to develop oedema than proximal surgeries.

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### Conflict of interest

The authors affirm that they have no conflicts of interest.

### REFERENCES

1. Perssons NH, Takolander R, Bergquist D. Lower limb oedema after arterial reconstructive surgery. Influence of preoperative ischaemia, type of reconstruction and postoperative outcome. *Acta Chir Scand.* 1989;155:259-66.
2. AbuRahma AF, Woodroof BA, Lucente FC. Edema after femoropopliteal bypass surgery: lymphatic and venous theories of causation. *J Vasc Surg.* 1990;11:461-7.
3. Esato K, Ohara M, Seyama A, Akimoto F, Kuga T, Takenaka H, et al. <sup>99m</sup>Tc-HSA lymphoscintigraphy and leg edema following arterial reconstruction. *J Cardiovasc Surg (Torino).* 1991;32:741-6.
4. Hannequin P, Clement C, Liehn JC, Ehrard P, Nicaise H, Valeyre J. Superficial and deep lymphoscintigraphic findings before and after femoropopliteal bypass. *Eur J Nucl Med.* 1988;14:141-6.
5. Haaverstad R, Johnsen H, Saether OD, Myhre HO. Lymph drainage and the development of postreconstructive leg oedema is not influenced by the type of inguinal incision. A prospective randomised study in patients undergoing femoropopliteal bypass surgery. *Eur J Vasc Endovasc Surg.* 1995;10:316-22.
6. Jacobs MJ, Beckers RC, Jörning PJ, Slaaf DW, Reneman RS. Microcirculatory haemodynamics before and after vascular surgery in severe limb ischaemia. The relation to postoperative oedema formation. *Eur J Vasc Surg.* 1990;4:525-9.
7. Campbell J, Harris PL. Akbumin kinetics and oedema following reconstructive arterial surgery of the lower limb. *J Cardiovasc Surg (Torino).* 1985;26:110-5.
8. Soong CV, Young IS, Lightbody JH, Hood JM, Rowlands BJ, Trimble ER, et al. Reduction of free radical generation minimises lower limb swelling following femoropopliteal bypass surgery. *Eur J Vasc Surg.* 1994;8:435-40.