

# Evaluation of vascular and metabolic deficiency in patients with large leg ulcers

**P Balaji FRCS**

Senior House Officer in Surgery

Leigh Infirmary, Leigh, Lancashire

**J G Mosley MRCP FRCS**

Consultant General and Vascular Surgeon

**Key words:** Leg ulcers; Arterial; Venous; Vitamin C

**A consecutive series of 50 patients with large leg ulcers (surface area >100 cm<sup>2</sup>) were investigated for evidence of arterial, venous and nutritional problems. Arterial insufficiency was found in 34%, venous reflux in 50%. A group of eight patients had no arterial or venous problem but had serious deficiencies of vitamin C and zinc. Arterial bypass was performed successfully in 15 of the 17 patients with arterial disease. All patients had a mesh split-skin graft. The 25 with venous incompetence had compression bandaging; in these patients the ulcer had healed on discharge but 10 had recurrent ulceration within 6 months. The leg ulcers in patients with corrected arterial insufficiency healed significantly more rapidly than those with venous incompetence. The ulcers in those with nutritional deficiency healed promptly after skin grafting and correction of the deficiency.**

**It is important to be aware of arterial insufficiency and nutritional deficiency in patients with leg ulcers, as such deficiencies may contribute to the non-healing of an apparently straightforward leg ulcer.**

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Large leg ulcers (surface area >100 cm<sup>2</sup>) are extremely difficult to heal on an outpatient basis (1). It has been our policy to admit such patients for vascular and nutritional studies before skin grafting the ulcers (2).

Numerous studies over the last 10 years have shown that about 20% of patients with leg ulcers have significant arterial insufficiency (3,4). Recent studies have shown that 80-90% of patients presenting with a femoral neck fracture have vitamin C deficiency. Further, it has been shown that when such a nutritional deficiency exists there is an increased risk of developing a pressure sore (5).

Most patients with large leg ulcers are elderly and at risk from arterial disease and nutritional deprivation (6,7).

This study was undertaken to assess the contribution of nutritional status, arterial insufficiency and venous problems in the causation of large leg ulcers.

## Patients and methods

A series of 50 patients were admitted for investigation of large non-healing leg ulcers. The mean age was 76 years (range 62-90 years) and 30 were female. All patients had the area of the ulcer measured by outlining the ulcer on acetate and recording the area by planimetry. The average area of the ulcer was 169 cm<sup>2</sup> (range 110-250 cm<sup>2</sup>).

All these patients had arterial circulation assessed by Doppler ultrasonography with an ankle/brachial pressure index <0.9 taken to indicate arterial disease. There were 17 patients with arterial insufficiency and they all underwent per femoral arteriography. Venous circulation was assessed by pulsed and continuous wave ultrasonography to indicate popliteal or superficial vein incompetence (8).

All the patients had a fasting blood sample taken for assay of various biochemical nutritional indices, including plasma zinc, albumin, folate, iron, urea, electrolytes and haemoglobin concentration.

Vitamin C depletion was assessed by a saturation test in which each patient took a loading dose of ascorbic acid and the urinary excretion was estimated over the following 4-6 h (9). All patients had wound swabs taken and a special effort was made to identify  $\beta$ -haemolytic streptococcal infection. The 10 patients with streptococcal infection received oral antibiotics for 2 weeks to cover the perioperative period (10).

Arterial reconstruction was performed and patency after bypass was assessed by Doppler ultrasonography. Patients who were vitamin C deficient received ascorbic acid (500 mg three times a day) and those with zinc deficiency received zinc sulphate (200 mg three times a day).

A meshed skin graft was used in all patients and covered for 7 days with a monofilament polyamide mesh to allow daily cleaning with betadine without disturbing the graft (11,12). All patients had the ulcer biopsied at the time of the skin graft.

After skin grafting, the 25 patients with venous insufficiency had a four-layer compression bandage until the ulcer was healed. They were then measured for a graduated elastic compression stocking before they were discharged.

Each patient was reviewed regularly after discharge to assess duration of healing.

The data was analysed statistically by Student's *t* test and significance at  $P < 0.05$  level.

## Results

In all, 17 patients had arterial insufficiency. In this group the mean ankle/brachial index was 0.32 (range 0–0.64). Twelve patients had a superficial femoral artery occlusion and five had a popliteal artery occlusion. A vascular bypass was successful in 15 patients. Twenty-five patients had popliteal vein reflux. The skin graft, which was performed at the same time as the arterial bypass, healed significantly more rapidly than a skin graft in the 25 patients with venous incompetence (Table I). The arterial reconstruction was unsuccessful in two patients, the ulcer deteriorated and an amputation was performed.

Metabolic deficiency was common in all these patients; indeed, 60% had appreciable vitamin C deficiency. There were eight patients with no evidence of arterial or venous

Table I. Comparison of healing of leg ulcers after meshed split-skin grafts in patients with venous or arterial disease

	Venous (n = 25)	Arterial (n = 15)
Inpatient stay (days)	37	28*
Healed at 2 years	14 (56%)	11 (75%)*
Mortality at 3 years	3 (12.5%)	10 (67%)

\*  $P < 0.05$

Table II. Metabolic and nutritional deficiencies among 50 patients with large leg ulcers. Seventeen patients had arterial insufficiency and 25 patients had venous deficiency

	Metabolic data			Total
	Arterial	Venous	Others	
Patients	17	25	8	50
Vitamin C deficiency	5	18	7	30
Zinc (< 10 $\mu\text{mol/l}$ )	0	3	6	9
Folate (< 150 $\mu\text{g/l}$ )	3	2	4	9
Iron (< 10 $\mu\text{mol/l}$ )	3	2	5	10
Albumin (< 38 g/l)	8	10	4	22
Diabetes	0	3	2	5

disease. They were generally more elderly and exhibited a variety of serious nutritional deficiencies (Table II).

There was no evidence of malignant change in any of the biopsies.

## Discussion

Leg ulcers are extremely common in the community with an incidence of 1–2/1000 over 45 years of age (3,4,13), while up to 1% of the population will suffer from leg ulceration during their lifetime (14).

After the introduction of simple hand-held Doppler ultrasonography, it became apparent that about 20% of those with leg ulcers had arterial insufficiency (3,4). Skene *et al.* (1) have previously demonstrated the difficulty in healing large leg ulcers (> 100  $\text{cm}^2$ ) and for this reason we have admitted these patients for vascular and metabolic studies. The high proportion with arterial insufficiency (34%) is probably because of selection of a group with particularly large indolent ulcers. The high proportion that could be improved by femoropopliteal or femorodistal bypass is encouraging, especially as it was associated with prompt and enduring healing of the skin graft. Unfortunately, the high 3-year mortality among these patients is a further reflection of their advanced generalised arterial problems.

The incidence of venous insufficiency at 50% is identical to the data from Nelgen *et al.* (8). However, we found none to have superficial venous disease, probably because those with large leg ulcers and superficial venous incompetence had undergone an operation before being admitted to our unit. One patient with recurrent ulceration had perforating vein ligation and subsequent grafting was successful (15).

The high recurrence rate of 40% within 6 months in those with venous ulceration is disappointing. However, it is similar to the recurrent ulcer rate hinted at by Moffatt *et al.* from Charing Cross Hospital (16). These workers were reviewing community care of much smaller venous ulcers, mean 4.2  $\text{cm}^2$ , compared with 170  $\text{cm}^2$  in this study.

They had a re-ulceration rate of 20% at 6 months. The work by Goode *et al.* (5), which showed that over 80% of patients admitted to Leeds hospitals with a femoral neck fracture had vitamin C deficiency, suggests that nutritional factors could play a part in leg ulcers in the community around Leeds hospitals.

It became apparent early in this study that many of these patients had a poor diet. Many are essentially housebound, while in addition it is surprising how many elderly people dislike fresh fruit and vegetables.

The high proportion with vitamin C deficiency (60%) was initially surprising. However, in a community nutritional study of elderly women in a nursing home 35% were found to have vitamin C level below 11  $\mu\text{mol/l}$ , which is the level found in clinical scurvy (17). Vitamin C deficiency has also been reported among elderly North Americans (18) and Chinese (19). We have not had an opportunity to study the incidence of vitamin C deficiency

in an age and sex matched local population. However, preliminary investigations among patients with pressure sores has demonstrated low levels in this group.

Vitamin C is important in collagen formation via hydroxylation of proline. The nutritional deficiency in many of these patients may explain the non-healing of these ulcers. It has been reported that pressure sores heal more rapidly after vitamin C supplements (20). Vitamin C also protects against coronary heart disease and reduces blood pressure (21).

Zinc is believed to facilitate wound healing and zinc supplements will improve clinical wound healing in zinc-deficient patients (22). In our study, zinc deficiency only occurred in 18% of the patients. However, in the group with no evidence of arterial or venous disease zinc deficiency was extremely common (75%), and combined with vitamin and protein malnutrition may have been influential.

All leg ulcers are contaminated by a wide variety of organisms including, in 20% of patients,  $\beta$ -haemolytic streptococci. This must be looked for specifically and, if present, eliminated by oral antibiotics if the graft is to take (10). We favour meshed skin, otherwise sepsis spreading below the graft will separate the entire graft from the ulcer bed.

A monofilament polyamide woven mesh was sutured over the skin graft. This has an open surface area of about 50% and enables the nursing staff to moisten and clean the skin graft and ulcer each day without disturbing it (11,12).

This study has demonstrated the multifactorial aetiology of large leg ulcers. It confirms that many with leg ulcers have an arterial occlusion which should be investigated as it may prove operable. In addition, we have identified a group of 16% of patients with large leg ulcers who have no evidence of arterial or venous disease but have serious nutritional deficiencies, particularly of vitamin C and zinc. Nutritional intervention can potentially serve not only to prevent the occurrence of significant morbidity but can also enhance the quality of life in the elderly patients (18).

Further work is now planned to identify the size of this nutritional problem in the community.

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Received 10 August 1994