Recent cases of trench foot

K. D. RAMSTEAD
M.B., B.Ch., B.Sc.

R. G. HUGHES
M.B. B.S., F.R.C.S.

A. J. WEBB
Ch.M., F.R.C.S., M.I.A.C.

Bristol Royal Infirmary

Summary

Two cases of cold injury to the lower extremities, 'trench foot', are presented. The management is essentially conservative, but in cases of severe damage, particularly in elderly people, amputation must be advised.

Introduction

'Trench foot' is the name used to denote a condition produced by prolonged exposure of the limbs to cold, damp conditions associated with immobility and constrictive clothing. The majority of cases reported have arisen directly from the exceptional conditions enforced on service personnel at times of war (Thompson, 1937; Ungley, Channell and Richards, 1946), although there have been more recent reports of young civilians with similar afflictions following exposure to wet and cold during prolonged sporting activities and adventure training (Fraser and Loftus, 1979; Marcus, 1979).

The population of the British Isles is not usually exposed to the conditions required to cause trench foot. In this paper, 2 cases are presented where the combination of old age and self neglect lead to it.

Case 1

A 65-year-old widow was admitted following a collapse at home. She gave a 2-week history of epigastric pain and was dehydrated, dirty and unkempt with a rigid, silent abdomen. Both feet were 'dusky' in colour with superficial blisters containing serous fluid over the dorsal surfaces. No pulses were palpable below the groins, and there was a clear line of demarcation of the colour changes at the ankles (Fig. 1). A diagnosis of perforated peptic ulcer and ischaemic feet was made; abdominal radiographs showed free gas below the diaphragm. It was decided to treat the perforation operatively and reconsider the condition of the feet when she had fully recovered.

Following resuscitation the perforated duodenal ulcer was treated by simple oversewing and cimetidine. She made a good postoperative recovery although she remained hypotensive throughout and there was no change in the state of her legs. On further questioning she denied any pain or loss of function of her feet. She had lived as a recluse for some years in a rat-infested, damp house with domestic waste covering all floors to a depth of 6 inches. She had been wearing a pair of ill-fitting suede boots continuously for as long as she could remember (Fig. 2). Neurological examination of her feet revealed no sensation over the area of colour changes, but ankle reflexes were present.

Despite an excellent postoperative recovery there was neither subjective nor objective improvement in her feet and 4 days later bilateral below knee amputations were performed. Histological examination of the feet showed no evidence of major arterial disease. There was epidermal necrosis with basal cell degeneration and early vesicle formation. The dermal and subcutaneous blood vessels were prominent and distended with blood, the underlying muscle bundles were microscopically normal although there were small patchy areas of interstitial haemorrhage.

The stumps healed readily by first intention and she proved to be exceptionally agile on her prostheses. Within 6 weeks she was walking unaided and at the time of writing is awaiting discharge to suitable accommodation.

Case 2

A 65-year-old man was admitted after he had been found lying in the road early one morning by the police. He was unable to give a history and was disorientated in time, place and person. He was wet and hypothermic (32°C) with bilateral scattered rhonchi in both lung fields and a raised jugular vein pulse. Both feet were cold, swollen and

FIG. 4. Case 2. Patient's boots.

FIG. 3. Case 2. Patient's feet.

discoloured with no foot pulses palpable (Fig. 3). There was no sign of scalp injury, skull radiography was normal and a chest X-ray revealed a right lower lobe pneumonia.

His general condition improved with a combination of antibiotics, physiotherapy and diuretics, but he remained demented. Over the next week dry gangrene developed in both feet, with a line of demarcation at the ankle. Examination of his admission clothing revealed a pair of boots the proximal limits of which corresponded to the areas of gangrene (Fig. 4). His mental state remained unchanged and, because of the possibility of toxic absorption, bilateral below knee amputations were performed. Good healing of the stumps occurred by first intention but there was no improvement in his dementia. Histological examination revealed similar changes to those of case 1. He is now able to walk on his prostheses with the aid of sticks and is awaiting a place in a psychogeriatric hospital.

Discussion

Causes of gangrene of the lower limbs are occlusive arterial disease, arterial emboli, diabetes mellitus, Raynaud's disease and drugs such as ergotamine. None of these were in evidence in the 2 cases, which appear to have been caused by a combination of moderate but not freezing cold, muscular inactivity, damp and constrictive clothing: a syndrome that is commonly referred to as 'trench foot'.

The first descriptions of the condition appeared following the Napoleonic campaigns (Larrey, 1812) but it was in World War I that it began to be seen regularly and from which it derives its name (Lorrain-Smith, Ritchie and Dawson, 1915). At the time, soldiers were spending long periods standing in flooded trenches, wearing tight army boots and puttees.

An upsurge of the disease was seen in World War II, when it was particularly noted in shipwrecked sailors confined to cramped waterlogged lifeboats and termed 'immersion foot' (Webster, Woolhouse and Johnson, 1942; Ungley *et al.*,

1946). These accounts grade the severity of the disease either by clinical appearances (Webster *et al.*, 1942) or, somewhat retrospectively, by the neurological damage present (Ungley, 1946). There are similarities in these 2 grading systems which are summarized in Table 1. Both papers stress that excellent results can be achieved by conservative management, using cooling and elevation only. These measures fail in patients with irreversible nerve damage, established gangrene or additional injuries. Few of those patients came to major amputation.

When one considers the histology of the amputation specimens it is obvious that the pathological change is largely one of disruption of tissue continuity and elevation of skin rather than arterial occlusion and cellular necrosis. Hence, if elevation to reduce oedema, and cooling to prevent reactive hyperaemia, can prevent further damage then debridement, grafting and tissue repair may restore normality.

While histological appearances and the recent literature (Fraser and Loftus, 1979; Marcus, 1979) support conservative therapy for this condition it may not be valid to extrapolate data from previously physically and mentally normal people to elderly patients having severe intercurrent disease. The priority is to recognize the disease early, and to differentiate it from cold injury from sub-zero temperature, namely frost bite. The latter disease, being associated with more severe climatic conditions and a demarcation that is not clearly associated with an item of clothing. In the elderly patient, it is naturally preferable to preserve the lower limbs if at all possible because of the problem of ultimate function with prostheses. However, this must be balanced against the problems of long-term bed rest in elderly patients such as pressure sores, hypostatic pneumonia, urinary infection, constipation and venous thrombosis. The pathological nature of the disease tends to favour healing of amputations by first intention rather than long-term problems common with arteriosclerosis and hence

TABLE 1. Grades of severity of trench foot

Grade	Webster, Woolhouse and Johnson, 1942	Ungley, Channell and Richards, 1946
Minimal	Erythema plus slight sensory changes	No, or only slight, interference with nerve function
Mild	Pitting oedema and sensory changes	Reversible nerve damage
Moderate	Pitting oedema, erythema, blebs and ecchymatic spots	Irreversible (degenerative) nerve lesions
Severe	Gross pitting oedema, blebs, massive extravasations of blood, and incipient gangrene	Irreversible (degenerative) nerve lesions and gangrene

N.B. Both reported cases fall into the severe grade.

the level of amputation may be conservative without prejudicing recovery. Conservative treatment of the damaged limbs also blurs the assessment of other concurrent pathology as it is well known that an ischaemic limb may have grave central effects which are rapidly ameliorated by amputation.

In conclusion, the authors would emphasize that doctors must be constantly aware that cold injury of the trench foot type may occur despite our comparatively mild climate. When it does occur, conservative therapy is undoubtedly indicated in the younger patient, but amputation at an early stage may well be the best course in the elderly patient, particularly those with intercurrent illness and a severe degree of trench foot.

Acknowledgment

We would like to thank Mrs Lynne Duffett for her patience in typing this manuscript.

References

- FRASER, I.C. & LOFTUS, J.A. (1979) 'Trench foot' caused by the cold. *British Medical Journal*, **1**, 414.
- LARREY, D.J. (1812) *Mémoires de Chirurgie Militaire et Campagnes*. Vol. iii, p. 60. Smith, Paris.
- LORRAIN-SMITH, J., RITCHIE, J. & DAWSON, J. (1915) Clinical and experimental observations on the pathology of trench frost bite. *Journal of Pathology and Bacteriology*, **20**, 159.
- MARCUS, P. (1979) 'Trench foot' caused by the cold. *British Medical Journal*, **1**, 622.
- THOMPSON, R.J.C. (1937) Frost bite and trench foot. *British Encyclopaedia of Medical Practice*, **5**, 440.
- UNGLEY, C.C., CHANNELL, G.D. & RICHARDS, R.J. (1946) The immersion foot syndrome. *British Journal of Surgery*, **33**, 17.
- WEBSTER, D.R., WOOLHOUSE, F.M. & JOHNSON, J.L. (1942) Immersion foot. *Journal of Bone and Joint Surgery*, **24**, 785.