Burning feet syndrome (BFS), which is characterised by a sensation of burning and heaviness in the feet and lower extremities, is a common disorder frequently encountered by general practitioners. In the past, this syndrome has been described only in anecdotal reports and has received scant attention in the medical literature. Grierson was, in 1826, the earliest to document such a symptom, but a detailed description was given by Gopalan in 1946, hence, BFS is also known as Grierson-Gopalan syndrome.

What causes ‘burning feet’?
There is no specific aetiology for BFS. It can occur as an isolated symptom or as part of a symptom complex in association with a variety of unrelated clinical settings. Based on the underlying mechanism, the various causes of BFS can be divided into the following categories (Table 1).

Nutritional causes
Since its initial descriptions, BFS has been postulated to be caused by vitamin deficiency. The specific vitamin, however, remains obscure, the deficient factor being variously attributed as riboflavin, nicotinic acid, thiamine, and pyridoxine. Most patients with burning feet show evidence of riboflavin deficiency. It is suggested that vitamin B deficiency leads to disturbance in cellular metabolism in the tissues causing accumulation of intermediate metabolites which may cause abnormal and excessive stimulation, or lower the pain and temperature threshold of peripheral sensory nerve endings. It is also thought that BFS is an early clinical phase of vitamin B12 deficiency related neuropathy before frank neurological signs appear. No other vitamins apart from the B-group have been implicated in the cause of BFS.

Other conditions associated with vitamin deficiencies such as chronic alcoholism, or patients on chronic hemodialysis, can develop BFS possibly due to associated nutritional deficiencies.

Metabolic or endocrinal causes
Burning feet is commonly seen with diabetes. Patients with signs and symptoms of burning feet may be part of diabetes related small fiber or autonomic neuropathies. The development of this symptom in diabetics is related to some extent to the severity and duration of the disease. Functional or organic abnormalities may be present in small unmyelinated-C fibers.
tional phase can precede organic structural damage and symptoms may develop without signs of overt neuropathy. Burning feet can also occur in other endocrine disorders such as hypothyroidism, though the mechanism is not completely understood.

**Hereditary**

Familial disorder with an autosomal dominant inheritance may cause BFS. The clinical picture is that of bilateral symmetrical pain with no muscle weakness, atrophy or foot deformity. Initially, it was thought that BFS may be the sole manifestation of an hereditary sensory neuropathy (HSN), but subsequently, molecular genetic studies excluded linkage to HSN locus on chromosome 9q22 and 3q13–q22. Therefore, it is concluded that autosomal dominant burning feet represents a distinct clinical entity in itself.

**Mechanical causes**

Burning feet syndrome may occur as a result of mechanical compression of the peripheral nerves (as seen in tarsal tunnel syndrome) and in diseases such as hypothyroidism, diabetes and rheumatoid arthritis. Nerve entrapment can occur at the level of the tarsal tunnel adjacent to the medial malleolus. Nerve entrapment due to sciatic mononeuropathy and spinal arteriovenous malformation can also cause burning feet.

**Psychosomatic causes**

Burning sensations and paraesthesia are among the commonest psychosomatic symptoms encountered in the general population. In a study by Keshavan et al., although many patients with burning feet had evidence of peripheral neuropathy, few also had psychological disorders.

**Miscellaneous causes**

Burning feet symptoms have also been reported in various unrelated clinical conditions. Erythromelalgia, also known as erythermalgia, is an uncommon disorder characterised by burning pain and redness of the extremities and may be primary or secondary to systemic disorders such as diabetes, collagen vascular disorders, or myeloproliferative disorders such as polycythemia vera or essential thrombocytosis. The symptoms of this disorder are probably related to intravascular platelet aggregation and may involve a hyperactive axon reflex in C-nociceptive fibers or a mutation of the capsaicin receptor.

Other unrelated and less common conditions with symptoms of burning feet are chronic mountain sickness, leishmaniasis, Gitelman syndrome (a rare renal tubular disorder), and carnitine deficiency state. Patients who do not reveal any abnormalities even after exhaustive laboratory investigations are usually labelled idiopathic.

**Clinical features**

Although no geographical or seasonal variation is known, BFS has been mainly reported in Asian and Far East countries during a hot summer. It is most common in those over 50 years, although it can occur in any age group. Usually discarded by physicians as vague and unimportant, the symptoms characterised by a burning sensation, heaviness, numbness, or a dull ache in the feet, can be extremely distressing to the patient. Burning is usually limited to the soles of the feet but may ascend to involve the dorsum, ankles or lower legs. The arms and palms of the hands are spared. A few patients occasionally complain of ‘pins and needles’ or tingling in the lower extremities.

Symptoms show worsening at night with day time improvement. Patients with underlying psychiatric disorders may present with a myriad of psychosomatic signs and symptoms in association with burning feet. On examination, there is a paucity of objective signs. The overlying skin and blood vessels are normal in most, while in some patients there may be accompanying erythema of the feet with warm overlying skin as in erythromelalgia. There is no local tenderness over the affected parts. Neurological examination is essentially normal in most patients but some may show a varying degree of hyporeflexia or hyper-aesthesia. Knee and ankle jerks show normal to brisk reaction, but are never absent or diminished. There are no signs of upper motor neuron involvement such as extensor plantars or increased tone. Motor power is maintained and there is no atrophy or wasting of the overlying muscles.

Most nutritionally deficient patients develop signs and symptoms of burning feet after approximately 4–5 months of deficient diet. Skin manifestations of vitamin deficiency such as scrotal dermatitis or pellagra-like rash can precede the onset of burning sensation in the feet. Some patients develop retrobulbar neuritis as a part of vitamin deficiency syndrome. Physical examination may be entirely normal, as in familial BFS.

**Table 1. Causes of BFS**

<table>
<thead>
<tr>
<th>Nutritional</th>
<th>Metabolic/endocrinal</th>
<th>Hereditary</th>
<th>Mechanical (entrapment neuropathies)</th>
<th>Psychosomatic</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin B deficiency</td>
<td>Diabetes mellitus</td>
<td>Autosomal dominant BFS</td>
<td>Tarsal tunnel syndrome</td>
<td>Erythromelalgia</td>
<td>Chronic mountain sickness</td>
</tr>
<tr>
<td>Malabsorption syndrome</td>
<td>Renal failure (dialysis patients)</td>
<td></td>
<td>Traumatic nerve compression</td>
<td>Chronic mountain sickness</td>
<td>Gitelman syndrome</td>
</tr>
<tr>
<td>Chronic alcoholism</td>
<td>Hypothyroidism</td>
<td></td>
<td></td>
<td>Leishmaniasis</td>
<td>Leishmaniasis</td>
</tr>
<tr>
<td>Renal failure (dialysis patients)</td>
<td></td>
<td></td>
<td></td>
<td>Multiple sclerosis</td>
<td></td>
</tr>
<tr>
<td>Chronic alcoholism</td>
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Reprinted from Australian Family Physician Vol. 31, No. 12, December 2002 • 1007
**Approach to the patient with burning feet**

As burning feet can occur in a wide spectrum of disorders, the approach to such a patient is not simple. A thorough clinical history and examination regarding nutritional status, vitamin deficiencies, and metabolic disorders such as diabetes and hypothyroidism, and a detailed family history are required in determining further investigations. Diagnostic tests are shown in Table 2. Although patients with burning feet should be evaluated for a secondary cause, an underlying psychosomatic illness as the cause of the symptoms should be ruled out by psychiatric assessment.

**Treatment**

Treatment of BFS depends on the cause. Management can be divided into general and disease specific measures.

**General measures**

General treatment for all cases of BFS includes reassurance about the benign nature of the disorder. Wearing open and comfortable shoes, especially those with arch supports, and wearing cotton socks is helpful. Soaking the feet in cold water (not ice cold) for around 15 minutes can bring symptomatic temporary relief. Avoidance of feet exposure to heat should be advised. Tricyclic antidepressants or membrane stabilising agents such as carbamazepine or gabapentin may be used for symptomatic relief.

**Disease specific measures**

As most cases of BFS occur as a consequence of malnutrition or vitamin deficiency, it is important to elucidate which particular vitamin is responsible for the condition. A suggested vitamin B treatment regimen is shown in Table 3 if a deficiency is detected. In patients with diabetes, small doses of insulin in addition to oral hypoglycaemic agents, adequate calories and vitamin supplements are helpful. Local application of capsaicin ointment and percutaneous nitroglycerine therapy may alleviate pain and burning. In erythromelalgia, treatment with aspirin typically produces rapid but short lived relief of symptoms. Elevation, cooling of limbs and systemic analgesia may be helpful. In mechanical cases such as tarsal tunnel syndrome, conservative treatment with arch supports and wider shoes may successfully relieve discomfort. If BFS is due to flat feet, orthotics may help restore the foot’s arch. If inflammation of the nerve is causing the compression, nonsteroidal anti-inflammatory drugs (NSAIDs) may be prescribed. In patients where pain is not relieved by NSAIDs, local injectable steroids may be beneficial. Surgical decompression to relieve nerve entrapment may be needed if conservative measures fail.

**Table 2. Useful diagnostic studies in BFS**

<table>
<thead>
<tr>
<th>Suspected clinical condition</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>In all patients</td>
<td>Complete blood count and red blood cell indices, routine biochemistry</td>
</tr>
<tr>
<td>Vitamin B deficiency or malnutrition</td>
<td>Serum levels of B group of vitamins like thiamine, riboflavin, and cyanocobalamin</td>
</tr>
<tr>
<td>Malabsorption syndrome (chronic diarrhea, postgastric surgery)</td>
<td>Tests for malabsorption</td>
</tr>
<tr>
<td>Diabetes (if signs/symptoms or risk factors for diabetes are present)</td>
<td>Oral glucose tolerance test</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>Thyroid function tests (T3, T4, TSH)</td>
</tr>
<tr>
<td>Erythromelalgia</td>
<td>Platelet count, bone marrow aspiration (to rule out myeloproliferative diseases such as essential thrombocytosis or polycythemia vera)</td>
</tr>
<tr>
<td>Gitelman syndrome (young patients with fatigue, muscle weakness, cramps and fasciculations or simply asymptomatic hypokalaemia)</td>
<td>Serum and urine electrolytes (magnesium, sodium, potassium and chloride)</td>
</tr>
<tr>
<td>Neuropathy, if present or strongly suspected</td>
<td>Electrophysiological studies (nerve conduction velocities, electromyography or nerve biopsy)</td>
</tr>
<tr>
<td>Familial inheritance</td>
<td>Molecular genetic studies</td>
</tr>
<tr>
<td>Mechanical cause (entrapment neuropathy)</td>
<td>Imaging studies such as MRI or CT</td>
</tr>
</tbody>
</table>

**Table 3. Suggested treatment regimen for BFS with injectable vitamin B preparations**

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Dose and duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riboflavin</td>
<td>6–10 mg intramuscularly for 2–3 weeks</td>
</tr>
<tr>
<td>Thiamine</td>
<td>50–100 mg intramuscularly for 2–3 weeks</td>
</tr>
<tr>
<td>Pantothenate</td>
<td>20–40 mg intramuscularly for 2–3 weeks</td>
</tr>
<tr>
<td>Nicotinic acid</td>
<td>100 mg intramuscularly for 2–3 weeks</td>
</tr>
<tr>
<td>Cyanocobalamin</td>
<td>1000 µg 3–4 times a week followed by twice a week for another week</td>
</tr>
</tbody>
</table>
Conclusion

Burning feet is a common complaint especially in the elderly and can occur in a variety of unrelated clinical settings. Common causes include diabetes mellitus, psychosomatic disorders and various vitamin deficiency states, rarely erythromelalgia or familial disorder. Mechanism involves vasomotor disturbances or altered pain and temperature threshold of peripheral sensory nerve endings. Treatment depends on the specific aetiology and includes injectable vitamin B preparations, membrane stabilising agents and cooling measures.

Conflict of interest: none declared.

References


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