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CASE REPORT

A British Second World War veteran with disseminated strongyloidiasis☆

G.V. Gill[a,*], N.J. Beeching[a], S. Khoo[a], J.W. Bailey[a], S. Partridge[b], J.W. Blundell[b], A.R. Luksza[b]

[a] *Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK*
[b] *Furness General Hospital, Barrow-in-Furness, Cumbria LA14 4LF, UK*

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Summary A case is described of a 78-year-old British veteran of the Second World War (1939–45) who was stationed in Southeast Asia and who developed a recurrent pneumonia with blood eosinophilia. He was treated with steroids, and eventually died with a severe *Pseudomonas* pneumonia. Just prior to death, larvae of *Strongyloides stercoralis* were identified in his sputum, and a specific serum ELISA test was later positive. At autopsy no other organs were involved, but bronchoalveolar carcinoma was found. Longstanding (57 years) chronic strongyloidiasis in a veteran who served in Southeast Asia but who was not a prisoner of war is very unusual. The pattern of dissemination was also not that of a true hyperinfection syndrome, and the case demonstrates the continued need for diagnostic vigilance amongst former soldiers who were based in the Far East.

1. Introduction

Strongyloides stercoralis is a nematode worm which is widely distributed in the tropics and subtropics (Grove, 1989). It has a complex life cycle, including the potential for auto-infection; a process which involves rhabditiform larvae penetrating the mucosa of the lower large intestine, or the peri-anal skin, and migrating through the tissues to the lungs. The infection may thus continue without any external soil cycle, potentially allowing subjects acquiring the infection in the tropics to remain infected (often without diagnosis) for many years, despite moving from the endemic area.

Strongyloidiasis is very common in Southeast Asia (particularly Thailand), and a well-known group of subjects who may have *Strongyloides* infections are veterans of the Second World War (1939–45) who were Far East Prisoners of War (FEPOW). In British former FEPOWs, for example, about 15% may be infected (Gill and Bell, 1979), and the condition has been recorded up to 50 years after leaving the endemic area at the end of the war (Gill and Bailey, 1994). Strongyloidiasis has also been reported in former FEPOWs in Australia (Grove, 1980), the USA (Pelletier, 1984), and Holland (Verburg and Geus, 1990), and in non-imprisoned military personnel serving in the same areas (Gill and Bell, 1987). In all these war veterans with chronic auto-infective

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* Corresponding author. Tel.: +44-151-529-4749; fax: +44-151-529-4688.
E-mail address: g.gill@liv.ac.uk (G.V. Gill).

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strongyloidiasis, the condition may be asymptomatic, but a common symptom is the 'larva currens' creeping eruption, representing larval migration to the lungs (Caplan, 1949). This is an urticarial, rapidly moving linear wheal, occurring on the central areas of the body. It is reported in over 80% of infected former British FEPOWs (Gill and Bell, 1979). Bowel symptoms are unusual—unlike in acute tropical infections, where abdominal pain and diarrhoea (and even malabsorption) are common presenting features (Boyajian, 1992).

Strongyloidiasis can be effectively treated with albendazole (Archibald et al., 1993) or ivermectin (Gam et al., 1994). Treatment is important, even in asymptomatic infections, since under conditions of reduced immunity, the disease can become severe and even fatal (Owar and Wamukota, 1976). This is known as 'hyperinfection', and is often due to immune suppression related to steroid treatment, malignancies, malnutrition, etc. Larvae migrate widely from the intestines to sites including the lungs, liver, and central nervous system (Stewart and Heap, 1985). Peritonitis, meningitis, and Gram-negative septicaemia may occur and the mortality is high.

We report here a British veteran who was stationed in the Far East who died with disseminated strongyloidiasis in 2002; 57 years after the end of Second World War. He had received steroid treatment and also had a bronchogenic carcinoma. The strongyloid infection had been previously undiagnosed.

2. Case report

A 78-year-old retired chemical worker presented to Furness General Hospital, Cumbria, UK, in October 2000 with an acute left upper and mid-zone pneumonia, requiring hospitalization and intravenous antibiotics. He had been a heavy smoker until 15 years previously, and for the past 5 years had hypertension and chronic obstructive pulmonary disease. Three years previously, Type 2 diabetes had been diagnosed. He was on treatment with metformin, bumetanide, ramipril, and inhalers of salbutamol, ipratropium, salmeterol, and fluticasone. Glycaemic control was good (HbA1c 7.1%), and renal, liver, and thyroid profiles were normal. His electrocardiogram showed a stable right bundle branch block.

The pneumonia resolved, but eight months later (May 2001) he was readmitted unwell, with further left mid-zone pneumonic shadowing on chest X-ray (Figure 1). A blood eosinophilia was noted of 890×10^6/l (normal up to 400), and antibiotics were again given. Bronchoscopy was performed to exclude an obstructing neoplasm, but this was negative. Pneumonic chest X-ray shadowing persisted and blood eosinophils remained slightly elevated at 440×10^6/l. A diagnosis of eosinophilic pneumonia was considered, and he was given prednisolone 10 mg daily. Three months later there was some clinical and radiological improvement, and blood eosinophils had fallen to 340×10^6/l. Prednisolone was reduced to 5 mg daily.

Figure 1 Chest X-ray of patient from May 2001 showing diffuse left mid- and upper-zone shadowing. Blood eosinophils at the time were 890×10^6/l.

Figure 2 Sputum microscopy of patient (stained with haematoxylin and eosin) showing a filariform larva of *Strongyloides stercoralis*.

In January 2002 (15 months after initial presentation), he was readmitted with further left sided pneumonia. He was hypoxic ($p0_2$ 7.6 kPa) breathing air, and in atrial fibrillation. Blood eosinophils were raised again at 740×10^6/l. He was given antibiotics and amiodarone, and prednisolone was increased to 30 mg daily. Though blood eosinophils fell to 340×10^6/l, there was only moderate clinical and radiological improvement. A repeat bronchoscopy two months later was again normal, and high dose steroids were maintained. Blood eosinophils were now 270×10^6/l. In July 2002 (21 months after his original pneumonic episode) he was hospitalized critically ill. His chest X-ray showed almost complete consolidation with cavitation of the left lung. Blood eosinophils were 560×10^6/l, and despite vigorous treatment with antibiotics, steroids and oxygen, he continued to deteriorate. Microscopy of a sputum sample revealed a larval worm provisionally identified as *S. stercoralis* (Figure 2). Enquiries revealed that the patient had served as a Second World War soldier in Singapore in 1945. He had not been a war prisoner, and had not served elsewhere. In 1990 he had returned briefly to the Far East on holiday. Albendazole 400 mg twice daily was started, but the patient died shortly afterwards. The clinical course of the patient is summarized in Table 1.

After death, the worm was confirmed to be a filariform larva of *S. stercoralis* and a specific serum ELISA test was positive. Autopsy revealed extensive consolidation and abscess formation in the left lung, the pus growing *Pseudomonas aeruginosa* on culture. *Strongyloides* larvae were not identified in

Table 1 Blood eosinophilia, treatment and clinical details in patient (October 2000—July 2002)

Date	Month of illness	Eosinophilia ($\times 10^6$/l)	Clinical details
October 2000	1		Presents with pneumonia
May 2001	7	890	Pneumonia recurrence
June 2001	8	440	Eosinophillic pneumonia? Prednisolone 10 mg daily
September 2001	11	330	Improved. Prednisolone 5 mg daily
January 2002	15	740	Further pneumonia
February 2002	16	340	Deteriorated Prednisolone 30 mg daily
April 2002	18	—	Prednisolone 10 mg daily
May 2002	19	270	Prednisolone 30 mg daily
July 2002	21	560	Final illness *Strongyloides* identified

the lungs, but there was a focal bronchoalveolar carcinoma in the right upper lobe, and infiltrating deposits of the same tumour in the left upper lobe. Other organs were unremarkable, and in particular, strongyloid larvae were not found.

3. Discussion

This case is of interest for a number of reasons. The patient was not a former FEPOW, but a British soldier who had served in Singapore at the end of the Second World War. He had returned to the area on holiday in 1990, but it seems unlikely that he would have contracted a *Strongyloides* infection at that time, which means that at the time of his death, the duration of infection was 57 years. The only other non-imprisoned Second World War soldiers from Britain who were based in Southeast Asia who have been found to have chronic strongyloidiasis are veterans of the Burma Campaign. Our own experience suggests a prevalence of only 0.5% amongst these men (Gill and Bell, 1987).

As far as we are aware, disseminated strongyloidiasis has only been recorded once before in a surviving British Second World War veteran who was stationed in Southeast Asia. This was a former FEPOW who had worked on the Burma Railway, and who was reported in 1985 by Stewart and Heap (1985). The patient had polymyositis on steroid treatment, and died with a pneumonic illness. Autopsy revealed a disseminated intense *S. stercoralis* infection, with larvae in the bowel, peritoneum, lungs, heart, and meninges, as well as evidence of Gram-negative septicaemia. This was clearly a case of true hyperinfection syndrome. Our patient however had dissemination only to the lungs. The eosinophilia and positive ELISA test clearly support longstanding strongyloidiasis, but apart from the larvae found in the sputum ante-mortem, no other organs were involved at autopsy. There was, however, a clinical scenario of immunosuppression, with bronchoalveolar carcinoma and steroid treatment. This 'pseudo-hyperinfection' has been recorded before. As long ago as 1911 a case from the southern USA was reported of a malnourished man who died with pneumonia and was found to have *Strongyloides* larvae in the sputum. At autopsy, larvae were found in the bowel and lungs only (Gage, 1911). In addition, an Australian former FEPOW who was stationed in Southeast Asia was reported by Kennedy et al. (1989). Whilst recovering from surgical resection of a bronchial carcinoma, he developed jejunal perforation requiring resection. The bowel was infected with *S. stercoralis* (thought to have caused the perforation), and larvae were also isolated from the sputum for several days. The patient recovered with thiabendazole treatment.

It therefore appears that under conditions of immune suppression, patients with chronic auto-infective strongyloidiasis may 'partially' disseminate larvae, rather than develop true hyperinfection syndrome, hence our term 'pseudo-hyperinfection'. Why this should occur is unknown. Regardless of this, however, our case demonstrates the need for continued vigilance in former soldiers who were stationed in the Far East and Southeast Asia. Cases of hyperinfection have almost certainly been missed in the past (Cook, 1987). The military and geographical history are obviously important. Eosinophilia in such patients is strongly suggestive of strongyloidiasis (Gill and Bailey, 1989; Schulte et al., 2002), and the modern serum ELISA test is sensitive and specific (Bailey, 1989; Schulte et al., 2002). In critically ill patients with disseminated strongyloidiasis, the ideal anthelmintic treatment is subcutaneous ivermectin (Chiodini et al., 2000), though this is normally a veterinary preparation only, and is thus difficult to obtain.

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