



Oesophagostomum bifurcum-induced nodular pathology in a highly endemic area of Northern Ghana

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Summary Human infection with *Oesophagostomum bifurcum* is rare globally, but focally endemic and common in Ghana and Togo. Two clinical presentations are identified: uni-nodular disease, which may be recognized as a 'Dapaong Tumour', and multi-nodular disease. Here, we describe the prevalence of *O. bifurcum* infection and the association with nodular pathology in northern Ghana. The study was performed in October 2002. Out of a well-defined population of approximately 18 000, 928 subjects of all ages were randomly selected for parasitological and ultrasound examination. In stool cultures, 44% had detectable third-stage *O. bifurcum* larvae present. Females were more often infected than males ($P < 0.05$). In 34% of the samples, nodules were detected along the colon wall, with the ascending and the transverse colon being the most affected regions. Significant correlations existed between the intensity of infection and the presence of nodules, both at the village and the individual level ($P < 0.001$ for both). Patients with multi-nodular pathology had significantly higher larval counts than patients with uni-nodular pathology. The

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present data suggest that nodular pathology, and probably the severity of the disease, are directly related to intensity of the infection.

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1. Introduction

Human oesophagostomiasis, normally due to infection with *Oesophagostomum bifurcum*, is rare in most parts of the world except in the northeastern part of Ghana and in northern Togo where it is common (Polderman et al., 1991). The prevalence and distribution of infection determined by copro-culture have been well described for the area; it is estimated that a quarter of a million people are infected, with one million more at risk (Pit et al., 1999b; Polderman et al., 1999).

The biology of transmission of this nematode is poorly understood but infection is presumably by oral ingestion of the L3 infective larvae. Ingested larvae of related species of veterinary importance are believed to assume a histotrophic phase of development in the colon wall and finally return to the lumen of the intestine to continue development into adult reproductive stages (Dash, 1973). Eggs produced by the female adult worm are passed with stool, and when deposited in conditions of favourable soil temperature and humidity, they normally hatch and develop into infective forms ready to infect another host within seven days.

During the histotrophic stage, nodules develop in the colon wall and these can be identified using ultrasonography. Occasionally, larvae migrate to extraintestinal sites such as the abdominal walls where nodules may occur as solitary, palpable and painful protruding masses. The palpable inflammatory mass around the larvae is usually referred to as a 'Dapaong Tumour' (Storey et al., 2000a). In others, invasion of the colon wall by large numbers of L3 larvae results in the development of many pea-sized, pus-filled, worm-containing nodular lesions, characterized by a grossly thickened and oedematous submucosa and subserosal layers of the colon (Storey et al., 2000b).

It so far remains unknown whether the development of pathology is first of all an expression of an extreme immune response in a particular subpopulation of infected subjects or a normal consequence of infection. In the present paper, we identify and describe the association between infection and pathology and discuss the extent to which *O. bifurcum* infections induce nodular pathology in a highly endemic area of northern

Ghana. The different types of subclinical nodular pathology are described in detail.

2. Materials and methods

2.1. Study area and subject selection

The study was conducted in Garu area within the Bawku East district of the Upper East Region of Ghana in October 2001 (latitude 10°50'W, longitude 0°50'N). The inhabitants of this area are of five ethnic origins: Kusasi, Mamprusi, Fulani, Busanga and the majority Bimoba. The study area covers about 150 (10 × 15) km² along the Ghana–Togo border and comprises 27 villages. The approximately 18 000 inhabitants of the study area live in 1570 compounds (mud-built structures for human dwelling). All villages and compounds were mapped with the aid of GPS version 12 (GPS 12, Garmin International, Inc., Olathe, KS 66062 USA) and all villages, compounds and individuals were registered and assigned unique identification numbers as civil registries are not available in the area.

From each of the 27 villages, we randomly selected 10% of the compounds to be included in the study. From the 142 compounds selected, 1476 individuals were available and after verbal explanation of the study by local interpreters, they were invited to submit stool samples for examination.

A total of 1314 (89%) persons provided stool samples, which were collected in labelled plastic containers. Coprocultures were performed in duplicate from each sample on the day of collection, as previously described (Polderman et al., 1991). After five to seven days of culture, larvae were microscopically identified at low magnification (100×) and counted. The characteristic third-stage larvae of *O. bifurcum* were distinguished from those of hookworm and *Strongyloides* spp. (Blotkamp et al., 1993).

All individuals for whom stool samples were available were invited to visit our mobile field clinic for clinical examination. Of the 1314 subjects for whom stool culture results were available, 928 subjects (71%) were examined. The rest were either absent or too old and weak to visit the ultrasound clinic. The examination consisted of

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