INTRODUCTION

Pentastomiasis is a zoonotic parasitic disease with an increasing number of documented human infections caused by the larval stages (nymphs) of pentastomes (tongue worms). These vermiform organisms form a unique phylum and are related to branchiurans. Pentastomes possibly coevolved with their respective vertebrate hosts, and adult parasites of most species live in the respiratory tract of snakes and other reptiles. Most human infections are caused by tropical and subtropical snake pentastomid parasites of the genus *Armillifer*, which encompasses species with different geographical distribution. *A. armillatus* and *A. grandis* are found in Africa, whereas *A. agkistrodonitis* has been reported in China and *A. moniliformis* in Southeast Asia. Human infection occurs after accidental ingestion of infective ova, which are shed into the environment by snake secretions and feces. Human pentastomiasis was reported among aborigines in West and East Malaysia in the 1960s (Table 1). The present report describes the third case of human visceral pentastomiasis in Sabah, Malaysian Borneo, caused by *A. moniliformis*, and it constitutes the first report of this disease after nearly 40 years in the whole of Malaysia.

CASE REPORT

A 70-year-old aboriginal farmer (Orang Asli) from Keningau, Sabah, East Malaysia (Figure 1), was admitted to the Queen Elizabeth Hospital, Kota Kinabalu, in October 2010 with a 1-month history of upper abdominal discomfort, weight loss, anorexia, jaundice, and dark urine. The patient lived in a rural area for his entire life. Imaging techniques showed a tumor of the head of the pancreas and a liver nodule containing a nymph of *A. moniliformis*. This report constitutes the first documented human pentastomid infection in the whole of Malaysia after nearly 40 years, and it is the third description from Malaysian Borneo. Cases of human and animal pentastomiasis in Malaysia are discussed.

Abstract. We report a case of visceral pentastomiasis caused by *Armillifer moniliformis* in a 70-year-old aboriginal farmer from rural Malaysian Borneo. The patient complained of upper abdominal pain, jaundice, and loss of weight. Radiological investigations and subsequent histopathological examination revealed an adenocarcinoma of the pancreas with an adjacent liver nodule containing a nymph of *A. moniliformis*. This report constitutes the first documented human pentastomid infection in the whole of Malaysia after nearly 40 years, and it is the third description from Malaysian Borneo. Cases of human and animal pentastomiasis in Malaysia are discussed.
molurus) and the Asian reticulated python (P. reticulatus) are known final hosts of A. moniliformis. In a survey, adult parasites were recovered from two of six P. reticulatus, a snake also endemic to Malaysian Borneo. It is well-known that consumption of snake meat is a common practice in some parts of Southeast Asia, and among the aboriginal tribes in Malaysia, the Temiar, Semai, and Temuan are known habitual python eaters. Risk factors for infection include consumption of undercooked contaminated snake meat as well as contact with living snakes and their secretions (i.e., tropical snake farming, pet keeping, harvesting of their skins, or tribal totemism). All of the human A. moniliformis infections in West and East Malaysia were indirectly linked to eating snakes by either the patient’s history or affiliation with a certain tribe (ethnicity), and thus, aboriginal people in rural areas are the population with the highest risk. In the case presented, the tribe of the patient was not determined, and no information about possible snake meat consumption was obtained. Another possible source of infection in Malaysian aborigines may be drinking of river water contaminated with snake secretions. In Malaysia, visceral pentastomiasis was also reported in wild and domestic animals as intermediate and final hosts (Table 2). In a large survey in 1981, the infection rate of different wild animals with nymphs of A. moniliformis was 1.7% in West Malaysia, with the highest individual number of parasites found in rodents and carnivores. Of the carnivora, 20.7% were infected.

Of note, in some human cases, the diagnosis of visceral pentastomiasis was achieved by X-ray and not histology. Thus, in theory, an Armillifer species different from A. moniliformis could have caused the visceral pentastomiasis in these patients, because the radiological picture cannot discriminate between the parasites involved. However, it is generally accepted that A. moniliformis is the only Armillifer species found in Malaysia, which is underlined by the other reports about human and animal visceral pentastomiasis with definitive species diagnosis in Malaysia. In one report about rats, the pentastome species responsible was termed Porocephalus armillatus, which might have been confused with A. (P.) moniliformis. In the present report, the parasite was diagnosed as a nymph of A. moniliformis based on morphology. Unfortunately, not enough tissue was available for polymerase chain reaction analysis and phylogenetic positioning of the parasite. Recent analysis revealed that the pentastome snake parasites from Africa (A. armillatus), China (A. agkistrodontis), and the Americas (P. crotali) clustered together in the minimal evolution model, indicating coevolution with their vertebrate final hosts. Armillifer nymphs have a body length of 9–23 mm, and A. moniliformis has been reported to have a minimal size of 11–12 mm in Malaysia. The species has about 30 rings, but
lower counts of 26 rings have also been reported. In contrast, the geographically nearest neighbor, *A. agkistrodonitis*, has only 7–9 spiral rings, whereas *A. armillatus* has 18–22 rings. To assess the full extent of human visceral pentastomiasis in Malaysia, serological prevalence studies in risk populations should be performed; these studies were used in a recent investigation from The Gambia and an earlier investigation from the Ivory Coast.

**Figure 3.** Sections of the nymph of *A. moniliformis*. (A) Rostral section of the parasite with four oral hooks. (B) Tapering posterior part of the parasite with annulations. (C) Close-up view of A. The mouth is surrounded by four hooks. (D) Annulated rings from the mid-body. (E) Close-up view of the oral hook. (F) Close-up view of a single annulated ring. All sections are stained with haematoxylin and eosin (Original magnification: A and B, 4×; C and D, 10×; E and F, 40×).

**Table 2.** Pentastomiasis among animals in Malaysia

<table>
<thead>
<tr>
<th>Host</th>
<th>Pentastome species</th>
<th>Organ</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cynomolgus monkey (<em>Macaca irus/fascicularis</em>)</td>
<td><em>A. moniliformis</em></td>
<td>n/a</td>
<td>Burns-Cox and others⁶</td>
</tr>
<tr>
<td>Giant swamp rat (<em>Rattus bowersi</em>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House geckoes*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild animals (rodents, primates, carnivores, and reptiles*)</td>
<td><em>Porocephalus armillatus</em></td>
<td>Lung, liver, spleen, and mesentery</td>
<td>Liat and Krishnasamy⁷¹</td>
</tr>
<tr>
<td>Wild animals (rodents, primates, carnivores, and reptiles*)</td>
<td><em>Railletiella hemidactyli</em></td>
<td>n/a</td>
<td>Liat and Sen²²</td>
</tr>
<tr>
<td>Cat</td>
<td><em>A. moniliformis</em></td>
<td>Abdominal cavity and lungs</td>
<td>Krishnasamy and others¹⁶</td>
</tr>
<tr>
<td>Wild animals</td>
<td><em>A. moniliformis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild animals (house lizards, snakes, and others)</td>
<td><em>A. moniliformis</em></td>
<td>Liver and spleen</td>
<td></td>
</tr>
<tr>
<td>Otter</td>
<td><em>A. moniliformis</em></td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Lizard*</td>
<td><em>Railletiella sp.</em></td>
<td>Lungs and mesenteries</td>
<td></td>
</tr>
<tr>
<td>Cockroaches</td>
<td><em>A. moniliformis</em></td>
<td>Kidney, liver, spleen, and mesenteries</td>
<td>Cheah and others³⁴</td>
</tr>
<tr>
<td>Wild rats</td>
<td><em>A. moniliformis</em></td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

n/a = Information not available.
*Final hosts.
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REFERENCES