SHORT REPORT: GNATHOSTOMIASIS IN MEXICO

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Abstract. Gnathostomiasis is an important food-borne parasitic zoonosis that is endemic mainly in Asian countries where some people prefer to eat raw freshwater fish. In North America, the first recorded case of gnathostomiasis was in Mexico in 1970, and the numbers of gnathostomiasis patients in Mexico seems to be increasing dramatically with time. However, the epidemiology of this disease in Mexico has never been described in detail. Here we review the current status of gnathostomiasis in Mexico.

Gnathostomiasis is an important food-borne parasitic zoonosis characterized by creeping eruptions and/or migrating erythemas with a local edema in the skin. In addition, the larvae sometimes migrate into various parts of the human body other than the skin causing a serious disease. Infection occurs by ingesting uncooked/undercooked meat of the intermediate/paratenic hosts contaminated with the larvae. Therefore, the disease is endemic mainly in Asian countries such as Thailand and Japan, where people prefer to eat freshwater fish. A few sporadic cases have also been reported from other parts of Southeast Asia. Since the first recorded case of gnathostomiasis in North America appeared in Mexico in 1970, the number of patients in Mexico seems to be increasing, although the epidemiology of this disease in Mexico has never been described in detail. We had an opportunity to carry out studies on this disease in Mexico on 1996. Here we review the current status of gnathostomiasis in Mexico.

The endemic areas in Mexico include six states (Figure 1): three sites along the Pacific coast (Culiacan, Sinaloa; Tec, Nayarit; and Acapulco, Guerrero), three sites near the Presidente Miguel Aleman Dam (Temascal and Tuxtepec, Oaxaca; and Tierra Blanca, Veracruz), and one site in north-eastern Mexico (Tampico, Tamaulipas) The estimated numbers of the patients in each site are summarized in Table 1. More than 1,000 cases, most of which were diagnosed based on clinical symptoms, have been found in Mexico. Almost all patients had eaten tilapia and/or other freshwater fishes as ceboche, a famous traditional Mexican raw fish dish several weeks to several months before the onset of the disease.

Informed consent was obtained orally from all patients for the use of photographs of skin lesions and the use of sera for immunodiagnosis. This study was reviewed and approved by the Ethical Committee of the University of Sinaloa. Clinical symptoms were characterized as migrating erythemas with a local edema appearing primarily in the periphery of the body, such as upper and lower extremities and the head (Figure 2A). Ocular migration was reported in one case. Creeping eruption (Figure 2B) was also noted in ap-

Figure 1. Areas endemic for gnathostomiasis in Mexico.
TABLE 1

<table>
<thead>
<tr>
<th>Town/city</th>
<th>State</th>
<th>Estimated no. of patients</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culiacan</td>
<td>Sinaloa</td>
<td>&gt;300*</td>
<td>1991–1996</td>
</tr>
<tr>
<td>Tepic</td>
<td>Nayarit</td>
<td>&gt;500</td>
<td>1988–1996</td>
</tr>
<tr>
<td>Acapulco</td>
<td>Guerrero</td>
<td>&gt;80</td>
<td>1990–1996</td>
</tr>
<tr>
<td>Temascal</td>
<td>Oaxaca</td>
<td>&gt;300</td>
<td>1980–1996</td>
</tr>
<tr>
<td>Tierra Blanca</td>
<td>Veracruz</td>
<td>&gt;100</td>
<td>1980–1996</td>
</tr>
<tr>
<td>Tampico</td>
<td>Tamaulipas</td>
<td>&gt;100</td>
<td>1990–1993</td>
</tr>
</tbody>
</table>

* Some of the patients in Culiacan and Temascal were diagnosed clinically and confirmed by immunodiagnosis, whereas all others were diagnosed only clinically.

proximately one-third of the cases. In most cases, relapse was observed over several years except otherwise patients were treated with albendazole. Morphologically, the larvae obtained from some patients (Figure 2C) by biopsy, as well as those obtained from fish and fish-eating birds in the endemic areas were similar to those of *Gnathostoma spinigerum*. 4, 7–9

Since the majority of patients were diagnosed only by clinical symptoms, we examined the specific antibody titers in the sera of patients with creeping disease in Mexico by ELISA using *G. doloresi* antigen. The feasibility of this assay for the diagnosis of gnathostomiasis in South America has already been established in Ecuador. 10 We also confirmed by our preliminary study that the sera of Mexican patients bound almost equally well with *G. doloresi*, *G. spinigerum*, and *G. hispidum* antigens (unpublished data). We examined 60 patients in Culiacan and Temascal and found that approximately 75% were positive by ELISA. The patients with skin lesions but who were seronegative by ELISA were either in the early stage of infection or were treated with corticosteroids in addition to albendazole.

Gnathostomiasis has long been considered as a food-borne parasitic zoonosis in Asian countries. 1, 2 However, the present results together with an outbreak of gnathostomiasis in Ecuador, 10–12 clearly show that gnathostomiasis is also a serious health issue in Latin America. As far as we could determine, gnathostomiasis or similar creeping diseases had never been reported in Mexico before 1970. 4 Because tilapia was imported and had been cultivated in the dammed waters of the endemic areas since 1964, mass production and commercial distribution of this fish seem to be responsible for an outbreak of gnathostomiasis in Mexico. 5, 7–9 Since the precise life cycle of Mexican gnathostomiasis remains unclear, it is impossible to reduce the infection in fish. The number of residents in the endemic areas of Mexico is large, and popular tourists areas such as Acapulco are located in endemic areas. Human infections are assumed to result from eating raw freshwater fish. Therefore, the only practical measure to prevent such infections is to refrain from eating raw fish that is served in popular dishes such as cebiche.

The most common clinical form of gnathostomiasis in Mexico is migrating lesions recurrently appearing in the periphery of the body such as upper/lower extremities and the head for several years. Such features are similar to those reported in patients infected with *G. spinigerum* in Thailand 1 and in Japan, 2 but are different from those infected with *G. hispidum*, *G. doloresi*, or *G. nipponicum* reported recently from Japan. 13–15 In infections with the latter three species, typical symptoms are creeping eruptions on the trunk with a duration of 2–3 months and no further relapse. In some cases, the larvae migrate out from the skin after albendazole treatment so that they were easily picked out with needles.

FIGURE 2. Cutaneous lesions of gnathostomiasis patients in Mexico. A, a migrating erythema with a local edema (arrowhead) that moved around above the left eyebrow of a 30-year-old woman living in Temascal. B, a creeping eruption observed on the left abdominal wall of a 58-year-old woman living in Nayarit. C, cross-section of a *Gnathostoma* larva in subcutaneous tissue from a biopsy of the left arm of a 25-year-old woman living in Culiacan. Note the cuticle with numerous spines and four cervical sacs, which are characteristic features of *Gnathostoma* (hematoxylin and eosin stained, scale bar = 200 μm).
or by scratching (Camacho SPD and others, unpublished data). Similar phenomena have already reported for patients treated with praziquantel in Thailand (Suntharasmai P and others, unpublished data).

Almeyda-Artiga\(^7\) designated the causative species of Mexican gnathostomiasis as \textit{G. binucleatum}\(^n.\) sp. based on the morphologic appearances of several adult worms found in ocelots and of larvae in fishes obtained from the Papaloapan river in Oaxaca-Veracruz. However, as mentioned above, clinical manifestations of gnathostomiasis patients Mexico are similar to those caused by infection with \textit{G. spinigerum}\(^n.\) in Thailand and Japan. Furthermore, morphologic appearances of the larvae collected from patients,\(^4\) fishes,\(^7\) \(^8\) and birds,\(^9\) in Mexico were identical with those of \textit{G. spinigerum} except for minor differences in the numbers of hooklets in each row on the head bulb.\(^9\) Acevedo-Hernandez and others reported that \textit{Gnathostoma} eggs found in feces of dogs and pigs in Temascal were morphologically similar to those of \textit{G. hispidum}.\(^16\) To draw any definitive conclusion as to whether Mexican \textit{Gnathostoma} is in fact a novel species or a geographic isolate of a known \textit{Gnathostoma} species requires identification of the final host in the natural life cycle in the endemic areas, collection of a large number of adult worms for morphologic identification, and experimental infections in various laboratory animals with the larvae collected from fishes and/or birds in the endemic areas. Together with such parasitologic studies, we are now conducting an analysis of clinical features of patients, and the applicability of serodiagnosis is now being investigated in Culiacan and other endemic areas.

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