REVIEW ARTICLE

INFECTIOUS DISEASES OF KHMER IMMIGRANTS IN THE UNITED STATES: REVIEW OF PUBLISHED REPORTS

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Infectious diseases are influenced by where patients have lived or travelled in the past, e.g., infection with *Schistosoma mekongi* can be acquired during freshwater contact in Cambodia, but not in the United States. Here the infectious diseases of Khmer immigrants in the United States were studied by reviewing published reports. Thirteen case series and 9 case reports of 5,222 patients were identified. Most reports were of infections with gastrointestinal parasites (8, 36%), *Plasmodium* species (3, 14%), *Mycobacterium tuberculosis* (3, 14%), and *Mycobacterium leprae* (2, 9%). Other reports included infections with *Burkholderia pseudomallei*, *Trichinella spiralis*, and *Schistosoma japonicum*. In conclusion, Khmer patients in the US can be infected with different gastrointestinal parasites, different extrapulmonary forms of tuberculosis have been reported, and 2 reports of *M. leprae* were identified. A country-specific database for origin and current residence for Khmer and other immigrant groups providing access to specialised information may be useful for clinicians taking care of immigrants.

Keywords: International Health, Immigrants, Cambodia

INTRODUCTION

Developing an infectious disease is influenced by where patients have lived or travelled in the past, e.g., infection with *Schistosoma mekongi* can be acquired during freshwater contact in Cambodia, but not in the United States.[1] Infection with *Trypanosoma brucei rhodesiense* can be contracted in game parks of East Africa after contact with Tsetse flies, but not in other parts of the world.[2]

Infectious disease information available specifically for patients living in a country and for travelers after returning from a visit to a foreign country is currently limited to medical textbooks, bibliographical databases (e.g., PubMed) or travel medicine websites (e.g., Mdtravelhealth.com). The data resources, however, do not include specific infectious diseases information which considers the country of origin and country of current residence of patients.

For clinicians taking care of patients from different countries it is difficult to have access to information detailing what infections people from different parts of the world develop when living as immigrants in another country.

In an attempt to collect related data infectious diseases reports of Khmer immigrant patients living in the United States were reviewed. Based on the reports Khmer patients in the US can have different gastrointestinal parasites, extrapulmonary forms of tuberculosis have been reported, and two reports of infections with *Mycobacterium leprae* were identified. A country-specific infectious diseases database for origin and current residence of Khmer and other patients would support clinicians taking care of immigrant patients.

METHODS

PubMed was searched for English language references published as of October 2009 using combinations of the following terms: 'Khmer', 'Cambodia', 'infection', 'case report', 'patient', 'refugee', 'immigrant'. Spelling variants of the search terms were included. Inclusion criteria were: reports describing infections of Khmer people living in the United States. Exclusion criteria: reports of infections in Khmer patients not living in the United States.

RESULTS

Thirteen case series and 9 case reports in total 5,222 patients were identified (Table-1). Most reports were of infections with gastrointestinal parasites (8, 36%) with the following frequencies for parasites: Hookworm: 14.9–92%, *Strongyloides stercoralis*: 4.4–38%, *Trichuris trichiura*: 21%, *Giardia lamblia*: 11.1–19.8%, and *Ascaris lumbricoides*: 10–18%. Three (14%) case reports of patients with infection with *Mycobacterium tuberculosis* were identified (age 17–28 years, mean 21.7 years). All patients had extrapulmonary tuberculosis: tuberculous peritonitis, military tuberculosis, and tuberculous enterocolitis. A diagnostic biopsy of peritoneum, lung, or bowel was required in all three patients. Two (9%) reports of infection with *Mycobacterium leprae* were identified. One report described the case report of a 22-year-old female with leprosy causing symptoms of carpal tunnel syndrome.[3]

The second report was a case series of 215 Khmer patients in the US with leprosy.[4] Three (14%) reports described 1,134 Khmer patients of which 532 (46.9%) had malaria with different *Plasmodium* species according to peripheral blood smear examination results. Single reports were identified for infections with

Trichinella spiralis (24 patients), *Entamoeba histolytica* liver abscess (1 patient), *Taenia solium* spinal cysticercosis (1 patient), and *Salmonella typhi* (1 patient). Infection with *Schistosoma japonicum* was described in a 25-year-old male with liver fibrosis and portal hypertension.

Table-1: Summary of published reports of infectious diseases of Khmer immigrants living in the United States

Year and Ref.	Study type	Patients No.	Patients Age (Yr)	Infection	Investigations	Management
Gastrointestinal parasites						
1989[8]	Case series	824	NS	Hookworm 210 (25.5%) *Giardia lamblia* 163 (19.8%) *Strongyloides stercoralis* 145 (17.7%)	Stool microscopy	Mebendazole, metronidazole, thiabendazole
1995[9]	Case series	110	NS	52(48%) parasites	Stool microscopy	NS
1981[10]	Case series	13	NS	Hookworm 12 (92%)	Stool microscopy	NS
1988[11]	Case series	2468	NS	*Giardia lamblia* 274 (11.1%) Hookworm 367 (14.9%) *S. stercoralis* 108 (4.4%)	Stool microscopy	NS
1982[12]	Case series	17	NS	*Ascaris lumbricoides* 3 (18%) Hookworm 9 (53%) *S. stercoralis*1 (6%)	Stool microscopy	NS
1885[13]	Case series	97	NS pregnancies (26 Khmer)	Hookworm 37% *Trichuris trichiura* 21% *Clonorchis sinensis* 20% *Ascaris lumbricoides* 10% *S. stercoralis* 10%	Stool microscopy	NS
1991[14]	Case series	271	NS	*Necator americanus*152 (56%) *Entamoeba histolytica* 118 (44%) *S. stercoralis* 78 (29%)	Stool microscopy	NS
1987[6]	Case series	111	NS	*Hookworm* 71 (55%) *S. stercoralis* 49 (38%) *Giardia lamblia* 19 (15%)	Stool microscopy	NS
Mycobacterium tuberculosis						
1986[15]	Case report	1	28, female	Tuberculous peritonitis	Peritoneal biopsy, histology and culture	Ethambutol, rifampin, pyrazinamide
1986[16]	Case Report	1	20, female	Miliary tuberculosis	Open lung biopsy, stain and culture	Isoniazid, streptomycin, rifampin, ethambutol
1991[17]	Case report	1	17, female	Tuberculous enterocolitis	Biopsy histology	Ileocolectomy Isoniazid, rifampin, pyrazinamide, ethambutol
Burkholderia pseudomallei						
1992[18]	Case report	1	43, male	Melioidosis spleen	Spleen needle biopsy	Splenectomy Ceftazidime, trimethoprim-sulfamethoxazole
Mycobacterium leprae						
1993[3]	Case report	1	22, female	Carpal tunnel syndrome	Nerve biopsy	Dapsone, rifampin, clofazimine
1992[4]	Case series	215	NS	Tuberculoid and lepromatous leprosy	Biopsy and skin smear	NS
Plasmodium species						
1982[19]	Case series	357	NS	One or more species 12 (3.4%)	Peripheral blood smear	NS
1993[20]	Case series	376	Male 299 (74%) Female 77 (26%) <20 years 80 (20%)	One or more species 178 (47%) *P. falciparum* 93 (52%)	Peripheral blood smear	Halofantrine
1996[21]	Case series	401	Male 289 (72%) Female 112 (28%)	One or more species 187 (58%) *P. falciparum* 62 (33%)	Peripheral blood smear	NS
Trichinella spiralis						
1986[22]	Case series	24	NS	Trichinosis	Serology Muscle biopsy	NS
Entamoeba histolytica						
1990[23]	Case report	1	32, male	Liver abscess	Liver histology	Liver resection Metronidazole
Schistosoma japonicum						
1988[24]	Case report	1	25, male	Hepatic fibrosis	Liver biopsy	Praziquantel Sclerotherapy Splenorenal shunt
Taenia solium						
1978[25]	Case report	1	43, male	Spinal cysticercosis	Cyst biopsy and histology	Laminectomy Cystectomy
Salmonella typhi						
1979[26]	Case report	1	25, female	*Salmonella typhi*	Blood cultures	Ampicillin

NS= Not stated

DISCUSSION

The 22 reports of 5222 Khmer patients with infections in the US included 8 studies of gastrointestinal parasites. The majority of Khmer patients in the 8 studies had arrived within less than a year from Cambodia or from refugee camps in Thailand. Nearly 50% of the recently arrived Khmer patients had an infection with a gastrointestinal parasite and of particular interest are infections with *Strongyloides stercoralis* in up to a third of Khmer patients. This nematode can be asymptomatic for years, but if the patient becomes immunocompromised, e.g., during treatment with corticosteroids or other immunosuppressive medications, the infection can disseminate throughout the body with a mortality of up to 87%.[5] Therefore infection with *Strongyloides stercoralis* and possible treatment should be considered in all Khmer patients especially when immunosuppressive drugs will be used.

Three case reports of 3 female Khmer patients described extrapulmonary tuberculosis infections of the peritoneum, miliary tuberculosis and entercolitis in young patients (17–28 years). In one study of Khmer immigrants in the US 54% had a positive tuberculin skin reaction[6] indicating that over 50% of Khmer patients have latent tuberculosis. Therefore infection with *Mycobacterium tuberculosis* is common, similar to many immigrants from developing countries, and should always be considered in the differential diagnosis not only for pulmonary tuberculosis, but also for other infections of e.g. brain, bone, and bowel.

Two reports described over 216 Khmer patients with leprosy suggesting that a substantial number of Khmer immigrants can be infected and could have undiagnosed infection with *Mycobacterium leprae*. Leprosy can present with hypopigmented macules, or skin changes similar to e.g. tinea corporis or eczema and not all clinicians may consider leprosy as the cause and investigate accordingly. Delay of diagnosis of leprosy is common in the US.[7]

It is not possible for most clinicians to be familiar with the above and other infections in Cambodia (e.g., schistosomiasis, trichinellosis, spinal cysticercosis). The available information sources textbooks, bibliography database (e.g. Pubmed), and travel medicine databases (e.g. Mdtravelhealth.com) however do not specifically provide relevant information according to country of origin and country of residence of patients.

A relevant database could be developed similar to National Center for Biotechnology Information (NCBI) and the Online Mendelian Inheritance in Man (http://www.ncbi.nlm.nih.gov/omim), e.g., a search for patients originally from Cambodia living in the US could report that in the US a third of Khmer immigrants (Table-1) were found to have infection with *Strongyloides stercoralis*.

in the listed studies. Or as part of the differential diagnosis of tinea corporis a search result could highlight leprosy and the 2 studies (Table).

However, it should be emphasized that the collected reports in this review are up to 30 years old and that case reports and case series commonly present unusual infections and presentations.

In summary, published infectious diseases reports of Khmer patients in the US were reviewed and revealed different infections of interest to clinicians, but not all commonly encountered in the US. A country-specific infectious diseases database for origin and current residence of Khmer and other immigrant patients would provide useful information currently not easily available to clinicians.

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