Clinical Manifestations and Risk Factors of Amebic Liver Abscess in Southeast Taiwan Compared with Other Regions of Taiwan

Huan-Lin Chen, Ming-Jong Bair,* I-Tsung Lin, Chia-Hsien Wu, and Yuan-Kai Lee

Division of Gastroenterology, Department of Internal Medicine, Mackay Memorial Hospital, Taitung Branch, Taiwan; Department of Nursing, Meiho University, Neipu, Pingtung, Taiwan; Department of Pharmacy and Graduate Institute of Pharmaceutical Technology, Tajen University, Yanpu, Pingtung, Taiwan

Abstract. Amebic liver abscess (ALA) had previously been endemic in Taiwan, particularly in the southern region, although its occurrence in the southeastern area was unknown. Thus, we conducted a retrospective study for southeastern Taiwan. We identified 14 patients who were diagnosed with ALA between July of 1995 and July of 2008. These patients were predominantly male and older in age. Most patients lived in rural areas (85.7%). Alcoholism (78.6%) and diabetes (35.7%) were risk factors for ALA. No human immunodeficiency virus (HIV) infections were detected. The most common clinical symptoms were fever (100%) and abdominal pain (100%). Short mean durations of symptoms, high bilirubin levels, and low albumin levels were also noted. Most patients (92.86%) had a single lesion, particularly in the right liver lobe (71.4%). Six patients also had secondary *Klebsiella pneumoniae* bacterial infections. Clinicians should be aware of the different risk factors in different regions when diagnosing amebic liver abscess in Taiwan.

INTRODUCTION

Amebiasis is a parasitic infection caused by *Entamoeba histolytica*. It is common throughout the world, particularly in tropical and subtropical regions, including Mexico, Central and South America, India, tropical Asia, and Africa.^{1,2} Poor sanitation and hygiene, suboptimal sewer systems, use of night soil for fertilization, and irrigation with untreated water all facilitate infections by *E. histolytica* that are associated with the oral-fecal pathway.^{1,3} The most frequent form of extraintestinal amebiasis is amebic liver abscess (ALA), although it occurs in less than 1% of patients with amebiasis. However, given the high prevalence of amoeba infestation in endemic areas, ALA still represents a large number of patients.^{1–3}

ALA had previously been endemic in Taiwan, particularly in the southern region of this island.⁴ Because of improvements in sanitary systems, public health measures, and personal hygiene, its prevalence had decreased in Taiwan until the appearance of more cases of human immunodeficiency virus (HIV) infection after 1995.^{2,5} Previous reports described the characteristics of ALA in the northern and southern regions of Taiwan,^{2,4–6} although they remain unknown for the southeastern area.

Thus, we conducted a retrospective study to acquire information on the diagnostic features, clinical presentation, risk factors, treatment, and outcomes of ALA in southeastern Taiwan. We also compared our findings with the findings in previous reports on Taiwan.

METHODS

Patients and data collection. The medical charts of all patients with a diagnosis of ALA (International Classification of Disease, Ninth Revision, code: 006.0–006.9) between July of 1995 and July of 2008 were retrospectively reviewed. Selected patients were enrolled at the Mackay Memorial Hospital, Taitung Branch, a major hospital in southeastern Taiwan. Detailed medical records included age, sex, underlying disease, duration of symptoms, length of hospital stay, clinical presentations, risk factors, laboratory

results, radiographic findings, treatment, and abscess size and location.

Diagnostic criteria for ALA. All patients were considered to have ALA if imaging studies revealed intrahepatic abscesses and were accompanied by histological, serological, or clinical evidence of amebic infection. Definite ALA patients had histological evidence of erythrophagocytic trophozoites identified in aspirates or biopsied tissue. Probable ALA patients were those patients with titers of > 1:128 by indirect hemagglutination (IHA) serologic assay or a greater increase in titer over a 2-week period. Other probable ALA patients without underlying biliary tract disease who responded well to metronidazole monotherapy but had positive imaging studies were also considered as ALA cases, even if their serum IHA titer was < 1:128.

Risk factors. Potential risk factors, including alcohol consumption; immunocompromised status caused by malignancy, steroid abuse, or HIV infection; travel to endemic areas; diabetes; and malnutrition, were also included in our analyses. Alcoholism was defined as daily alcohol consumption of > 80 g for many years. Diabetes mellitus was identified by a clinical history of medicine use related to this disease. Serum albumin levels of < 3.0 g/dL were considered to reflect malnourished status. HIV was diagnosed by positive HIV serum test using a Western blot assay and a detectable viral load.

Statistical analysis. Statistical analyses used SPSS 12.0 for Windows (SPSS, Chicago, IL). Results for continuous variables are given as means $\pm$ SDs and were compared using Student's *t* tests. Results for categorical variables are given as numbers (percentages) and were compared using χ^2 tests. All tests were two-tailed, and *P* < 0.05 was considered significant.

RESULTS

In total, 14 patients were diagnosed with ALA in this 13-year retrospective study, including 6 patients with definite cases and 8 patients with probable cases. Eleven patients were male, and three patients were female (male to female ratio = 3.67:1). Patients' ages ranged from 24 to 85 years; their mean age was 52.64 ± 10.3 years. Most patients lived in rural areas (12; 85.7%), where the hygiene standards may have been low. Only one patient had traveled to mainland China 1 month before admission; he experienced respiratory distress and

*Address correspondence to Ming-Jong Bair, No. 1, Lane 303, Changsha Street, Taitung, Taiwan. E-mail: a5963@ttms.mmh.org.tw

shock on arrival. Eleven patients (78.6%) were alcoholics, five of whom experienced severe intoxication episodes. Five patients had diabetes. No HIV infections were detected among 11 HIV serum tests.

At presentation, the most common clinical symptoms were fever (all 14 patients; 100%) and abdominal pain (100%), particularly in the right upper quadrant and the epigastric area. Other non-specific complaints included jaundice ($N = 3$), anorexia ($N = 3$), diarrhea ($N = 2$), and cough ($N = 2$). The mean duration of symptoms before hospitalization was 5.5 ± 2.1 days (range = 1–31 days). Most ALA patients ($N = 10$; 71.4%) had IHA titers of $> 1:128$. Four patients had IHA titers that remained at $< 1:64$ during the entire treatment course; however, these patients were definite cases and had typically good responses to metronidazole therapy. Two of them had non-reactive results for IHA titers, even with repeated examinations during admission. Only one male patient had positive microscopic examinations for amoeba in stool specimens.

Most patients ($N = 12$; 85.7%) exhibited leukocytosis; the mean white blood cell (WBC) count was $15,430 \pm 9,363$ cells/ μL (range = 8,270–37,900 cells/ μL). However, mean hemoglobin (12.96 ± 4.83 g/dL) and platelet (247.8 ± 105 K/ μL) levels were within normal limits. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels were elevated 1- to 10-fold in all of these patients; the mean values were 133.4 ± 58.5 IU/L for AST and 110 ± 40.3 IU/L for ALT. Eight patients had twofold increases in alkaline phosphate (Alk-P) levels. High bilirubin levels were also noted in these patients; five patients had levels of > 2 mg/dL. The mean bilirubin level was 2.97 ± 1.45 mg/dL. Most of these patients ($N = 12$; 85.7%) were malnourished, with a mean albumin level of 2.45 ± 1.2 g/dL. Chest involvement symptoms were observed in five patients, particularly one middle-age male patient.

All patients underwent either an abdominal ultrasonography or a computed tomography examination. An abscess diameter of > 5 cm was found in eight patients; the mean abscess diameter was 5.69 ± 2.1 cm. Most patients ($N = 13$; 92.9%) had a single lesion, particularly in the right liver lobe ($N = 10$; 71.4%). Three lesions were found in the left lobe. Only one patient had multiple lesions in bilateral liver lobes; he also had underlying diabetes. Liver abscess aspirates were obtained from eight patients, and they were used for micro-

scopic examination and bacterial culture. Trophozoites were identified in six liver abscess aspirates under microscopic examination. All of the aspirates also had positive bacterial cultures for *Klebsiella pneumoniae*; this bacterium was also isolated from blood samples.

All of these patients had good responses to medical treatment with metronidazole and antibiotics (either ceftriaxone or cefmetazole). For eight patients who had percutaneous fine-needle aspiration for diagnosis or treatment, no complications resulted from this procedure. The mean treatment duration was 15.8 ± 4.5 days (range = 10–35 days). No severe ALA complications were noted; only one patient experienced respiration distress on arrival and required ventilation support. The patients' conditions during hospitalization were benign, and all patients were alive at the time of discharge. Follow-ups were generally uneventful.

COMPARISONS

We identified 14 ALA patients over a 13-year period in a major hospital in southeastern Taiwan. We compared the demographic characteristics of these ALA patients with the characteristics of patients in previous reports for Taiwan (Table 1).^{2,4–6} ALA patients were predominantly male in each region of Taiwan, similar to the result reported in review papers.^{1,7} However, the mean age of our patients was 52.64 ± 10.3 years, which was older than HIV-infected groups.^{2,5,6} In addition, patients with alcoholism and diabetes were high-risk groups for ALA compared with previous reports for northern and southern Taiwan, where HIV infection and travel to endemic areas were risk factors for ALA.

Based on comparisons of the clinical characteristics of patients with ALA from different regions of Taiwan (Table 2),^{2,4–6} patients in southeast Taiwan had the shortest duration of symptoms before their admission. In all regions, the two most frequent symptoms were fever and abdominal pain. Other symptoms, such as diarrhea, jaundice, weight loss, dyspnea, and anorexia, were non-specific findings. Most patients had high IHA titers, leukocytosis, abnormal liver function test results, and high Alk-P levels. In addition, compared with other regions, our patients had high bilirubin levels, and most patients were malnourished based on low albumin levels.

TABLE 1
Demographic characteristics of ALA patients from different regions of Taiwan

	Study				
	Lee and others ⁵	Chuah and others ⁴	Hsu and others ²	Wu and others ⁶	This study
Year	1985–2007 (22.5 years)	1981–1989 (9 years)	1990–2006 (16 years)	1990–2007 (17 years)	1995–2008 (13 years)
Region	Northern Taiwan	Southern Taiwan	Northern Taiwan	Southern Taiwan	Southeastern Taiwan
Case number	27	125	37 (33 for analysis)	24	14
Male:female	8:1 (24:3)	5.25:1 (105:20)	33 male	5:1 (20:4)	3.67:1 (11:3)
Mean age, years	41.2	NA (one-half > 50 years)	37.24	52.7	52.64
Underlying disease					
Alcoholism	1 (3.7%)	8 (6.4%)	NA	NA	5 (35.7%)
Biliary disease	NA	NA	NA	NA	1 (7.1%)
Diabetes mellitus	1 (3.7%)	3 (2.4%)	1 (3.0%)	1 (4.2%)	5 (35.7%)
Trauma	NA	NA	NA	NA	1 (7.1%)
Risk factors					
Drinking	1 (3.7%)	8 (6.4%)	NA	NA	11 (78.6%)
Travel to endemic area	6 (22.2%)	NA	8 (24.2%)	NA	1 (7.1%)
HIV infection	13 (48.1%)	NA	28 (84.8%)	8 (33.3%)	0/11 (0%)
Malignancy	NA	2 (1.6%)	NA	NA	NA

NA = not analyzed.

TABLE 2
Clinical characteristics of ALA patients from different regions of Taiwan

	Study				
	Lee and others ⁵	Chuah and others ⁴	Hsu and others ²	Wu and others ⁶	This study
Symptom duration	17.77	10.768	NA	9.9	5.5
Clinical manifestation					
Fever	24 (89.9%)	111 (88.8%)	23 (69.7%)	24 (100%)	14 (100%)
Abdominal pain	22 (81%)	116 (92.8%)	18 (54.5%)	18 (75%)	14 (100%)
Diarrhea/bloody stool	4 (14.8%)	18 (14.4%)	11 (33.3%)	7 (29.2%)	2 (14.28%)
Jaundice	3 (11.1%)	29 (23.2%)	NA	NA	3 (21.43%)
Right flank pain	NA	NA	4 (12.1%)	NA	NA
Anorexia	NA	31 (24.8%)	3 (9.1%)	4 (16.7%)	3 (21.43%)
Cough	NA	15 (12%)	6 (18.2%)	NA	2 (14.28%)
Dyspnea	NA	17 (13.6%)	NA	NA	1 (7.14%)
Weight loss	2 (7.41%)	29 (23.2%)	3 (9.1%)	2 (8.3%)	0
Laboratory data					
IHA titer	> 1,024:13 (48.15%)	NA	> 128:29 (87.88%)	> 128:22 (91.67%)	> 128:10 (71.42%)
Hemoglobin (g/dL)	11.64	NA	NA	11.7	12.96
< 12 g/dL	NA	27 (21.6%)	NA	NA	2 (14.28%)
WBC (/μL)	14,805.8	NA	13,117.5	14,900	15,430
> 10,000/μL	22 (81.5%)	113 (90.4%)	NA	NA	12 (85.72%)
ALT (IU/L)	52.63	NA	80.55	58.8	110
> 40 IU/L	NA	83 (66.4%)	NA	NA	10 (71.43%)
Bilirubin T (mg/dL)	1.063	NA	Normal	3.25	2.97
> 2.0 mg/dL	NA	45 (36%)	NA	NA	5 (35.71%)
Albumin (g/dL)	NA	NA	NA	2.6	2.45
< 3.0 g/dL	NA	111 (88.8%)	NA	NA	12 (85.27%)
ALK-P (IU/L)	313.17	NA	342.9	216.8	123.71
> 90 IU/L	NA	110 (88%)	NA	NA	8 (57.14%)

ALT = alanine aminotransferase; NA = not analyzed.

The radiographic characteristics of ALA were similar in all regions (Table 3),^{2,4-6} such as large single lesions in the right liver lobe. Some of our patients had chest involvement, which was also found in other regions. One different finding among our ALA patients in southeast Taiwan was secondary bacterial infection (6 of 14 patients; 42.86%), and all patients were infected with *K. pneumoniae*. In a study of 125 patients in south Taiwan,⁴ only 6 patients (4.8%) had secondary bacterial infections, such as infections with *Klebsiella pneumoniae* and *Escherichia coli*.

Treatment outcomes were excellent in all regions with low mortality rates (Table 4). Most patients had received amebicide therapy (tinidazole or metronidazole) and echo-guided aspiration like our patients received. Surgical intervention was usually not necessary, although it was performed for 20% of

patients in the study by Chuah and others.⁴ However, the outcomes were still very good with a low mortality rate (2.4%).

DISCUSSION

ALA was previously endemic in Taiwan, particularly in the southern and southeast regions of this island.^{3,4} Because of improvements in sanitation systems, public health measures, and personal hygiene, the prevalence of amebiasis is now low in Taiwan.⁵ However, most of our patients lived in rural areas where hygiene and sanitation standards may still be low, which may be a major risk factor for ALA in southeastern Taiwan.

Our study also revealed that our ALA patients were predominantly male, which was similar to results of previous studies done in different regions of Taiwan^{2,4-6} and other

TABLE 3
ALA characteristics in different regions of Taiwan

	Study				
	Lee and others ⁵	Chuah and others ⁴	Hsu and others ²	Wu and others ⁶	This study
Abscess					
Size	7.1	7.982	NA	7.6	5.69
Size > 5 cm	NA	102 (81.6%)	NA	NA	8 (57.14%)
Single	20 (74.1%)	88 (70.4%)	NA	20 (83.3%)	13 (92.86%)
Multiple	7 (25.9%)	15 (12%)	NA	4 (16.7%)	1 (7.14%)
Right lobe	20 (74.1%)	103 (82.4%)	NA	19 (79.2%)	10 (71.43%)
Left lobe	7 (25.9%)	12 (9.6%)	NA	NA	3 (21.43%)
Bilateral lobe	NA	10 (8%)	NA	NA	1 (7.14%)
Complication					
Peritonitis	1 (3.7%)	15 (12%)	3 (9.1%)	3 (12.5%)	0
Chest involved	13 (48.15%)	40 (32%)	5 (15.2%)	14 (58.3%)	5 (35.71%)
Bacterial infection	NA	6 (4.8%)	NA	NA	6 (42.86%)

NA = not analyzed.

TABLE 4
ALA treatments and outcomes in different regions of Taiwan

	Study				
	Lee and others ⁵	Chuah and others ⁴	Hsu and others ²	Wu and others ⁶	This study
Treatment					
Duration (days)	18.4	NA	14.9	13.6	15.8
Medicine only	7 (25.9%)	93 (74.4%)	NA	1 (4.2%)	6 (42.86%)
Medicine + drainage	18 (66.7%)	7 (5.6%)	NA	22 (91.6%)	8 (57.14%)
Medicine + OP	2 (7.4%)	25 (20%)	NA	1 (4.2%)	0
Outcome					
Cure	26 (96.3%)	122 (97.6%)	33 (100%)	24 (100%)	14 (100%)
Mortality	1 (3.7%)	3 (2.4%)	0	0	0
Recurrence	NA	NA	3 (9.1%)	NA	0

NA = not analyzed; OP = operation.

countries.^{1,7} It remains unclear why there is a sex difference, although several hypotheses have been proposed, including heavy alcohol consumption by men,⁸ hormonal effects in pre-menopausal women that may modulate infection,⁹ and a possible protective effect of iron deficiency anemia among menstruating women.¹⁰

Our study revealed two risk factors for ALA, alcoholism and diabetes, that differed from other regions of Taiwan, although they are common risk factors for ALA.^{1,5,7} Taitung, located in southeastern Taiwan, has the highest proportion of aboriginal residents,¹¹ and a high prevalence of alcoholism among aborigines was reported (44.2–55.2%) during the 1990s.¹² Thus, alcoholism is a significant risk factor in southeast Taiwan because of its higher prevalence than in other regions of Taiwan. In addition, poor knowledge regarding health, limited access to healthcare, and poor diabetes control were noted in contrast to western Taiwan. Along with the above factors, diabetes is a remarkable risk factor in other regions of Taiwan. In a study of 67 patients by Katzenstein and others,¹³ male sex, chronic alcoholism, and diabetes were risk factors for ALA in southeast Taiwan.

However, HIV infection and previous history of travel to endemic areas were risk factors for ALA in northern and southern Taiwan. In our study, only 11 patients had had HIV serum tests since 2000, and all tests were negative. According to statistical data for HIV infection from the Centers for Disease Control in Taiwan,¹⁴ the prevalence of HIV infection in southeast Taiwan is lower than in other regions. Thus, it was not identified as a risk factor in our study. In addition, only one of our ALA patients had visited mainland China before his admission. Poor public transportation and relatively low socioeconomic status in southeast Taiwan may be the reasons for this finding.

Our ALA patients were also older than ALA patients in other regions of Taiwan. Several previous studies done in northern and southern Taiwan showed that those patients with ALA or high IHA titers were younger in groups with HIV infection than non-HIV-infected populations.^{2,5,6,15} Amebiasis among HIV-infected patients is most likely transmitted through high-risk behavior, such as unprotected oral–anal contact, rather than background environment transmission. Thus, the demographics of ALA patients differ considerably.⁶

The main presenting symptoms were fever and abdominal pain in all regions of Taiwan.^{2,4–6} These two symptoms were also the most common clinical manifestations based on a review of the literature,^{1,7,10,16,17} even for those patients with moderate or severe disease. These symptoms were also common for HIV- and non-HIV-infected groups.^{2,5,6}

Based on laboratory test results, most ALA patients had high IHA titers, leukocytosis, abnormal liver function test results, and high Alk-P titers. These findings were similar to the findings reported in most of the literature. The radiographic characteristics of ALA were also similar in all regions,^{2,4–6} such as the finding of a large single lesion in the right liver lobe of liver, and they were common findings in other reports.^{1,7–10,16,17} Thus, the clinical characteristics and radiographic characteristics of ALA are similar throughout the world, and they are not different in different groups based on geographic region, HIV infection, or severity of disease. However, elevated bilirubin levels (2.97 mg/dL) and low albumin levels (2.45 g/dL) were noted in our study, and these risk factors indicate a poor prognosis. These two laboratory findings may also be related to chronic alcoholism and poor diabetes control.

One specific finding for ALA in southeast Taiwan was secondary bacterial infection (42.86%). These patients were all infected with *K. pneumoniae*, which was more prevalent in other regions of Taiwan. Although the prevalence of alcoholism and diabetes was higher, some studies indicated that amebic infection may depress the human immune system.^{1,18,19} Depressed T-cell activity has been found during acute amoebiasis.^{1,19} Some parasitic diseases also stimulate a host's immune system to switch from a Th1 to Th2 response. Cytokines produced by activated Th2 cells further enhance Th2-type responses and inhibit the Th1 arm of the immune system, thereby contributing to granuloma formation, eosinophilia, hyperimmunoglobulin, and increased susceptibility to bacterial and fungal infections.^{18,20,21} Thus, the proportion of patients with secondary bacterial infection was higher than in other regions of Taiwan.

The overall outcomes of treatment were excellent in all regions with low mortality rates. In our study, symptoms duration was shorter before admission, because most of our patients were from rural areas. The standards of hygiene and sanitation in these areas may often be low, and clinicians should pay more attention to the possibility of ALA. Thus, our patients had the shortest symptom duration and excellent outcomes. In a study of 125 patients by Chuah and others,⁴ it was suggested that, if a diagnosis could be made early, conservative treatment with amebicides and abscess aspiration offered a chance for cure from either mixed bacterial infections or abdominal rupture.

There were some limitations for our study. First, because of its retrospective nature, all of our patients did not have HIV antibody tests. Second, because of the small sample size, the power of multivariate analysis was relatively low. Third, compared with other reports for Taiwan, some clinical and laboratory characteristics were not clear.

CONCLUSION

We noted some characteristics of amebic liver abscess that were different between the southeast region and other regions of Taiwan. Our patients were generally older and had the risk factors of alcoholism and diabetes. High bilirubin levels and low albumin levels were also noted. In addition, the prevalence of secondary bacterial infection was higher among our patients. However, in our study, excellent outcomes were achieved with early diagnoses. There were no significant differences in terms of symptoms and signs, radiographic findings, other laboratory test results, and hospital courses between these two groups of patients. Clinicians should be aware of the different risk factors involved in different regions when diagnosing amebic liver abscess in Taiwan.

Received May 29, 2013. Accepted for publication September 11, 2013.

Published online October 28, 2013.

Authors' addresses: Huan-Lin Chen, Ming-Jong Bair, I-Tsung Lin, Chia-Hsien Wu, and Yuan-Kai Lee, Division of Gastroenterology, Department of Internal Medicine, Mackay Memorial Hospital, Taitung Branch, Taiwan, E-mails: naturehuen@yahoo.com.tw, a5963@ttms.mmh.org.tw, a5820@ttms.mmh.org.tw, a5696@ttms.mmh.org.tw, and a6322@ttms.mmh.org.tw.

REFERENCES

1. Wells CD, Arguedas M, 2004. Amebic liver abscess. *South Med J* 97: 673–682.
2. Hsu MS, Hsieh SM, Chen MY, Hung CC, Chang SC, 2008. Association between amebic liver abscess and human immunodeficiency virus infection in Taiwanese subjects. *BMC Infect Dis* 8: 48–52.
3. Chen HL, Chang WH, Shih SC, Lin SC, Wang TE, Chu CH, Chen YJ, Pang KK, Bair MJ, 2008. Simultaneous *Klebsiella pneumoniae* and amoebic liver abscess in an immunocompetent patient. *Am J Med Sci* 335: 379–381.
4. Chuah SK, Chang-Chien CS, Sheen IS, Lin HH, Chiou SS, Chiu CT, Kuo CH, Chen JJ, Chiu KW, 1992. The prognostic factors of severe amebic liver abscess: a retrospective study of 125 cases. *Am J Trop Med Hyg* 46: 398–402.
5. Lee YJ, Chen KJ, Yang CH, Lin YC, Liu HY, Liao ST, Lee YJ, 2009. Characteristics of amebic liver abscess in patients with or without human immunodeficiency virus. *J Microbiol Immunol Infect* 42: 500–504.
6. Wu KS, Tsai HC, Lee SS, Liu YC, Wann SR, Wang YH, Mai MH, Chen JK, Sy CL, Chen KM, Chen YJ, Chen YS, 2008. Comparison of clinical characteristics of amebic liver abscess in human immunodeficiency virus (HIV)-infected and non-HIV-infected patients. *J Microbiol Immunol Infect* 41: 456–461.
7. Shyam M, RS G, Alok M, Narendra B, 2002. Clinical profile of amoebic liver abscess. *The Journal, Indian Academy of Clinical Medicine* 3: 367–373.
8. Seeto RK, Rockey DC, 1999. Amebic liver abscess: epidemiology, clinical features, and outcome. *West J Med* 170: 104–109.
9. Shandera WX, Bollam P, Hashmey RH, Athey PA, Greenberg SB, White AC Jr, 1999. Hepatic amebiasis among patients in a public teaching hospital. *South Med J* 91: 829–837.
10. Hoffner RJ, Kilagblian T, Esekogwu VI, Henderson SO, 1999. Common presentations of amebic liver abscess. *Ann Emerg Med* 34: 351–355.
11. Wu SI, Liu SI, Fang CK, Hsu CC, Sun YW, 2006. Prevalence and detection of alcohol use disorders among general hospital inpatients in eastern Taiwan. *Gen Hosp Psychiatry* 28: 48–54.
12. Cheng AT, Chen WJ, 1995. Alcoholism among four aboriginal groups in Taiwan: high prevalences and their implications. *Alcohol Clin Exp Res* 19: 81–91.
13. Katzenstein D, Rickerson V, Braude A, 1982. New concepts of amoebic liver abscess derived from hepatic imaging, serodiagnosis, and hepatic enzymes in 67 consecutive cases in San Diego. *Medicine* 61: 237–246.
14. Centers for Disease Control, 2004. *Statistics of Communicable Diseases and Surveillance Report in Taiwan Areas*. Taiwan: Centers for Disease Control.
15. Tsai JJ, Sun HY, Ke LY, Tsai KS, Chang SY, Hsieh SM, Hsiao CF, Yen JH, Hung CC, Chang SC, 2006. Higher seroprevalence of *Entamoeba histolytica* infection is associated with human immunodeficiency virus type 1 infection in Taiwan. *Am J Trop Med Hyg* 74: 1016–1019.
16. Lee KC, Yamazaki O, Hamba H, Sakaue Y, Kinoshita H, Hirohashi K, Kubo S, 1996. Analysis of 69 patients with amoebic liver abscess. *J Gastroenterol* 31: 40–45.
17. Hughes MA, Petri WA Jr, 2000. Amebic liver abscess. *Infect Dis Clin North Am* 14: 565–568.
18. Lodhi S, Sarwari AR, Muzammil M, Salam A, Smego RA, 2004. Features distinguishing amoebic from pyogenic liver abscess: a review of 577 adult cases. *Trop Med Int Health* 9: 718–723.
19. Salata RA, Martinez-Palomo A, Canales L, Murray HW, Trevino N, Ravdin JI, 1990. Suppression of T-lymphocyte responses to *Entamoeba histolytica* antigen by immune sera. *Infect Immun* 58: 3941–3946.
20. Lambertucci JR, Rayes AA, Serufo JC, Nobre V, 2001. Pyogenic abscesses and parasitic diseases. *Rev Inst Med Trop Sao Paulo* 43: 67–74.
21. Lambertucci JR, Rayes AA, Serufo JC, Gerspacher-Lara R, Brasileiro Filho G, Teixeira R, Antunes CM, Goes AM, Coelho PM, 1998. Schistosomiasis and associated infections. *Mem Inst Oswaldo Cruz* 93 (Suppl 1): 135–139.