Scientific Research Publishing

Advances in Infectious Diseases, 2024, 14, 595-605
https://www.scirp.org/journal/aid
ISSN Online: 2164-2656
ISSN Print: 2164-2648

Profile of Amoebic vs. Pyogenic Liver Abscess and Comparison of Demographical, Clinical, Radiological, and Laboratory Profiles of These Patients from Three Secondary Care Centers in Senegal

Agbogbenkou Tevi Dela-Dem Lawson[1,2], Daouda Thioub[1,2], Ndiaga Mbengue[1], Ndeye Amy Sarr[1], Sylvie Audrey Diop[1,2]

[1]Service des maladies Infectieuses et tropicales de l'Hôpital de Tivaouane, Tivaouane, Sénégal
[2]UFR des sciences de la sante de l'Université Iba Der Thiam de Thiès, Thiès, Sénégal
Email: lawsalomon@yahoo.fr

How to cite this paper: Lawson, A.T.D.-D., Thioub, D., Mbengue, N., Sarr, N.A. and Diop, S.A. (2024) Profile of Amoebic vs. Pyogenic Liver Abscess and Comparison of Demographical, Clinical, Radiological, and Laboratory Profiles of These Patients from three Secondary Care Centers in Senegal. *Advances in Infectious Diseases*, **14**, 595-605.
https://doi.org/10.4236/aid.2024.143043

Received: April 26, 2024
Accepted: September 8, 2024
Published: September 11, 2024

Abstract

Background: Liver abscess (LA) is a suppurated collection in the hepatic parenchyma. In Africa, liver abscesses are most often of amoebic origin, but more recently, the rate of pyogenic liver abscesses (PLA) has increased. **Objective:** to assess the epidemiological characteristics, clinical features, biological radiological findings, and outcomes of patients with PLA and with amebic liver abscess (ALA) in order to determine the potential factors that may help improve diagnosis and treatment for LA in the context of secondary care centers with limited medical supports. **Methods:** Retrospective review of LA diagnosed and treated at three secondary care centers in Thiès over 11 years. **Results:** 61 patients, were included, 52.45% had ALA and 47.54% had PLA. Males were predominant (79.31% in PLA vs 65.63% in ALA, p = 0.2). The median age was 38 years for the PLA group vs 39 years for the ALA group (p = 0.4). In both groups, the most common symptom was right upper abdominal pain (81.97%), hepatomegaly (81.97%). The PLA group had a higher prevalence of fever (79.31% vs 46.88%, p = 0,009), chills (51.72% vs 18.75%, p = 0.007), right basi-thoracic pain (55.17% vs 28.13%, $p = 0.032$), and jaundice (55.17% vs 28%, $p = 0.032$). There was no difference in radiological features between PLA and ALA. Patients with PLA had a higher level of White blood cell (20.600 vs 15.400, p = 0.014). The most common bacteria identified in PLA were *Escherichia coli* (58.8%). All patients had received antibiotic therapy, which was combined with aspiration puncture (37.3%), transcutaneous drainage (43.3%), and surgery (9.0%). Seven patients had received antibiotic

therapy alone and all had amoebic abscesses. Elsewhere, the occurrence of complications was higher in PLA cases (75.86% vs 37.5%, p = 0.003). The overall hospital mortality rate was 13.11%, higher in cases of PLA (24.14% vs 3.13%, p = 0.022). **Conclusion**: Clinical and biological features were more severe in PLA. But radiological features cannot be used to distinguish between PLA and ALA.

Keywords

Profile, Liver Abscess, Amoebic, Pyogenic, Senegal

1. Introduction

Liver abscess (LA) is a suppurated collection in the hepatic parenchyma, caused by a pathogenic agent that may be bacterial, parasitic or fungal. It is relatively rare, with a difficult to assess, as it varies from one region to another. However, LA cases have increased over the last fifty years [1] [2].

In our context, African, amebic etiology was the most common cause of liver abscess [3] [4]. Pyogenic liver abscesses appeared rarer, and caused mainly by Gram-negative bacilli and anaerobes; they are more common in Europe, where its prevalence varies from 0.29 to 1.47% [5]. The characteristic clinical picture of the disease remains Fontan's triad (a combination of fever, right upper abdominal pain, and hepatomegaly). However, in most cases, the presentation remains subtle and non-specific.

Diagnosis of LA is facilitated, thanks to the progress made in recent decades in the field of biological and, above all, morphological investigations. Nevertheless, confirmation of the etiology remains difficult in Africa due to limited access to the necessary biological investigations [6]. The diagnosis of certainty is based on the demonstration of abscesses on liver imaging and aspiration of the abscess contents, with microbiological examination. PCR is considered the gold standard to confirm the amoebic nature of abscess for patients living in endemic areas. However, serology is still the most widely used in routine practice due to the unavailability of PCR in most of African countries. Moreover, the amoebic nature can be made simply based on epidemiological evidence, combined with the chocolate-coloured appearance of the pus, which is sterile on culture [7] [8].

For pyogenic abscesses, positive culture of the pus confirms the diagnosis. The prognosis of LA depends on the patient's condition, the speed with which the diagnosis is made, the rapid initiation of treatment, the occurrence of complications, and the etiology PLA/ALA and underlying conditions [9] [10].

Diagnosis of amoebic or pyogenic is of utmost importance. Thus, we undertook this study to compare epidemiological characteristics, clinical features, biological and radiological findings, and outcomes of patients with pyogenic liver abscess (PLA) vs amebic liver abscess (ALA) in order to determine the potential factors that

may help improve diagnosis and treatment for this disease in African care system.

2. Methods

2.1. Study Population

We included in this study all consecutive patients with LA admitted to the three public hospitals of Thies, from January 2012 to December 2022. These patients were identified by searching the International Classification of Disease code (ICD 10 code = K750) for the diagnosis of LA from the hospital databases during that period. Medical records were evaluated by the Hospital Archival records system. Data collected included demographic characteristics, clinical features, laboratory data, radiological findings of abdominal ultrasound (number, size and location of lesions), computed tomography (CT), and chest X-rays, microbiological findings, diagnostic and therapeutic methods (LA drain gage/aspiration/ surgery and antibiotics), outcomes (complications and hospital mortality).

2.2. Diagnostic Criteria (PLA, ALA)

Study patients were considered to have LA if image studies had demonstrated the presence of intra-hepatic abscesses and were accompanied with biological, or clinical evidence of amebic infection or pyogenic liver abscess. Two typical conditions were classified as ALA. Patients with a titer over 1:128 in the indirect hemagglutination (IHA) serologic assay were included in the group of ALA cases. Patients, with bacterial culture negative, and chocolate appearance of pus who responded well to metronidazole monotherapy (defined by fever or other clinical symptoms/signs improvement after 3 days of metronidazole monotherapy) but had positive image studies were also considered as ALA cases, even in case of IHA titer was less than 1:128. Pyogenic abscess was defined as bacterial culture positive, if bacterial culture was negative, purulent appearance or predominantly neutrophil appearance was considered.

2.3. Statistical Analysis

Data were analyzed using R. Studio. All results are expressed as mean ± SD, median (range), or frequency (%) as appropriate. Quantitative variables, expressed as means ± SD, were compared using the Wilcoxon-Mann-Whitney test. The association between two categorical variables was tested using the Chi-square test or Fisher's exact test, wherever appropriate. A p-value < 0.05 was considered statistically significant.

3. Results

During the study period, among 47,553 patients hospitalized during the same period, 67 patients were retrieved in the hospital database. 61 patients were finally diagnosed according to the study criteria, 32 (52.45%) ALA and 29 (47.54%) PLA, representing 0.12% of inpatients (**Figure 1**). More than half of the patients (60%) were managed in surgical departments.

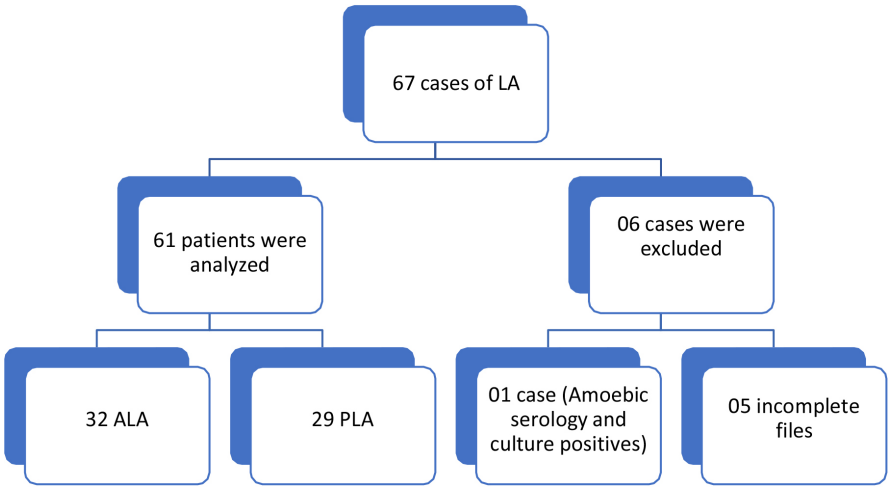

Figure 1. Chart flow.

3.1. Epidemiological and Clinical Features

Among the epidemiological characteristics studied, only smoking was more prevalent in the PLA group, with a significant difference (58.62% vs 28.13%); p = 0.016). Results are presented in Table 1.

Table 1. Epidemiological characteristics of pyogenic and amoebic livers abscess cases.

Epidemiological Characteristics	**Total**, n = 61	**ALA**, (n = 32)	**PLA**, (n = 29)	**p-Value**
Age	39 [28 – 50]	38 [27 – 47]	39 [28 – 58]	0.4
Sex				0.2
Female	17 (27.87%)	11 (34.38%)	6 (20.69%)	
Male	44 (72.13%)	21 (65.63%)	23 (79.31%)	
Comorbidities	22 (36.07%)	11 (34.38%)	11 (37.93%)	0.8
HIV	2 (7.14%)	0 (0.00%)	2 (16.67%)	0.2
Hypertension	16 (26.23%)	6 (18.75%)	10 (34.48%)	0.2
Diabetes	6 (9.84%)	2 (6.25%)	4 (13.79%)	0.4
Chronic renal disease	2 (3.28%)	0 (0.00%)	2 (6.90%)	0.2
Prior diarrhea	26 (42.62%)	13 (40.63%)	13 (44.83%)	0.7
Digestive surgery	5 (8.20%)	2 (6.25%)	3 (10.34%)	0.7
Smoking	26 (42.62%)	9 (28.13%)	17 (58.62%)	0.016
Alcohol	11 (18.03%)	6 (18.75%)	5 (17.24%)	0.9

3.2. Clinical Features

In both groups, the most common symptom was right upper abdominal pain (81.97%), hepatomegaly (81.97%). The PLA group had a higher prevalence of fever (79.31% vs 46.88%, p = 0.009), chills (51.72% vs 18.75%, p = 0.007), right basis-thoracic pain (55.17% vs 28.13%, $p = 0.032$), and jaundice (55.17% vs 28%,

$p = 0.032$). Results are presented in Table 2.

Table 2. Clinical features of livers abscess (PLA and ALA) cases.

Clinical features	Total n = 61 (%)	ALA n = 32 (%)	PLA n = 29 (%)	p-Value
Right upper abdominal pain	50 (81.97)	24 (75.00)	26 (89.66)	0.14
Abdominal pain	39 (63.93)	21 (65.63)	18 (62.07)	0.8
Abdominal distension	23 (37.70)	9 (28.13)	14 (48.28)	0.10
Vomiting	25 (40.98)	11 (34.38)	14 (48.28)	0.3
Diarrhaea	26 (42.62)	13 (40.63)	13 (44.83)	0.7
Right thoracic pain	25 (40.98%)	9 (28.13)	16 (55.17)	0.032
Cough	23 (37.70)	10 (31.25)	13 (44.83)	0.3
Sputum	15 (24.59)	5 (15.63%)	10 (34.48)	0.088
Dyspnea	11 (18.03)	3 (9.38)	8 (27.59)	0.065
Fever	38 (62.30)	15 (46.88)	23 (79.31)	0.009
Chills	21 (34.43)	6 (18.75)	15 (51.72)	0.007
Alteration in general condition	55 (90.16)	28 (87.50)	27 (93.10)	0.7
Jaundice	25 (40.98)	9 (28.13)	16 (55.17)	0.032
Hepatomegaly	50 (81.97)	27 (84.38)	23 (79.31)	0.6
Condensation	11 (18.03)	2 (6.25)	9 (31.03)	0.012
Pleural effusion syndrome	24 (39.34)	10 (31.25)	14 (48.28)	0.2

[1]n (%).
[2]test du khi-deux d'indépendance; test exact de Fisher.

3.3. Radiological Features

There were no differences in the radiological characteristics of ALA compared with PLA. Ultrasonogram of the abdomen showed right lobe involvement in 87.50% cases and left lobe involvement in 7.14%. The involvement of both lobes was related to PLA only. The result are presented in Table 3.

3.4. Laboratory Features

Hyper leukocytosis was much greater in PLA cases (20.600 vs 15.400, p = 0.014) (Table 4).

3.5. Diagnosis and Microbiology

In ALA group, amoebic serology was positive for 18 patients, 14 patients had chocolate appearance of pus and bacterial culture negative. In the PLA group, bacterial culture was positive for 16 patients, 13 patients had bacterial culture negative, amoebic serology negative, but purulent appearance or predominantly neutrophil appearance. Bacteria were identified via fluid aspiration from the abscesses (16/31). The most common bacteria identified were *Escherichia coli* (62.5%, 10/16); *Klebsiella pneumoniae* (18.75%, 3/16); *Pseudomonas aeruginosa*

Table 3. Radiological features of pyogenic and amoebic liver abscesses.

Ultrasound features	**Total**, N = 611	**ALA**, N = 321	**PLA**, N = 291	**p-Value**
Heptatic arrow, cm (median)	15 (15.0 – 16.4)	15,0 (14.8 – 15.9)	16.0 (15.0 – 17.0)	0.15
Abscess stage				>0.9
Pre-suppurative	16 (28.07)	9 (31.03)	7 (25.00)	
Suppurative	37 (64.91)	18 (62.07)	19 (67.86)	
multiwall abscess	4 (7.02)	2 (6.90)	2 (7.14)	
Location of abscess				0.2
Right lobe	49 (87.50)	25 (89.29)	24 (85.71)	
Both lobes	3 (5.36)	0 (0.00)	3 (10.71)	
Left lobe	4 (7.14)	3 (10.71)	1 (3.57)	

[1]n (%).
[2]Test de Wilcoxon-Mann-Whitney; Test exact de Fisher.

Table 4. Summary of laboratory results at presentation in patients with pyogenic and amoebic liver abscess.

Laboratory results	**Total**, N = 61	**ALA**, N = 32	**PLA**, N = 29	**p-Value**
WBC (median)	18,300 (13.400 – 23.200)	15,400 (12.478 – 21.700)	20,600 (17.700 – 24.100)	0.014
HB (median)	10.4 (8.0 – 11.5)	11.0 (8.6 – 12.0)	10.0 (6.90 – 11.0)	0.11
CRP	92 (41 – 192)	59 (20 – 121)	102 (48 – 213)	0.081
Creatinine	11 (9 – 13)	11 (9 – 12)	11 (9 – 22)	0,3
ASAT	68 (30 – 93)	36 (31 – 81)	82 (30 – 98)	0.14
ALAT	54 (26 – 74)	40 (25 – 63)	64 (27 – 75)	0.2
Bilirubine	43 (34 – 48)	40 (35 – 54)	43 (33 – 47)	>0.9
PAL	366 (350 – 579)	369 (337 – 789)	363 (358 – 368)	>0.9
GGT	112 (103 – 197)	149 (130 – 167)	110 (95 – 208)	0.9
TP	75 (60 – 90)	78 (69 – 92)	69 (57 – 79)	0,016
Albumine	30.0 (25.3 – 32.8)	32,5 (31.3 – 33.8)	28.0 (23.8 – 31.5)	0.4

[1]Test de Wilcoxon-Mann-Whitney; Wilcoxon rank sum exact test.

(12.5%, 2/16) and *Xanthomona spp.* (6.25%, 1/16).

3.6. Outcomes

More than half of patients (55.74%) had developed at least one complication during hospitalization. These were predominantly right pleural effusion (76.3%), pneumopathy (20%), peritonitis (15.8%) and septic shock (10.5%), two of which occurred in post-surgery. Elsewhere, it should be noticed that the occurrence of a complication was significantly associated with the type of abscess, with a higher rate in cases of pyogenic abscess (75.86% vs 37.50%; p = 0.003). The overall hospital mortality rate was 13.11%, furthermore, it was higher in cases of PLA (24.14% vs 3.13%; p = 0.022). The results are presented in Table 5.

Table 5. Evolution of liver abscess cases.

Evolution	Total, n = 61 (%)	ALA n = 32 (%)	PLA n = 29 (%)	p-Value
Diagnostic delay (median)	10 (7 – 15)	8 (7 – 15)	14 (7 – 20)	0.025
Surgery	10 (16.39)	4 (12.50)	6 (20.69)	0,5
Complications	34 (55.74)	12 (37.50)	22 (75.86)	0.003
Recurrence	6 (9.84)	2 (6.25)	4 (13.79)	0.4
Hospital duration (median)	13 (9 – 17)	12 (8 – 15)	15 (10 – 22)	0.077
Time to apyrexia (median)	5.0 (3.0 – 8.0)	5.0 (3.0 – 8.0)	5.0 (2.8 – 7.3)	>0.9
Lethality	8 (13.11)	1 (3.13)	7 (24.14)	0.022

4. Discussion

Amoebic liver abscess is the most common type of abscess in tropical areas. It is the main extra-intestinal complication of amoebiasis, occurring in 3 to 9% of cases [11]. Its frequency in hospital varies greatly from countries in Africa, and it accounted for 0.1 to 0.2% of hospital admissions in Dakar [9] [12]. In Europe, its prevalence is 0.7%, and mainly concerns migrants [1]. Pyogenic liver abscesses are rarer in tropical areas, but account for 80% of LA in Western countries [11].

The median age of our patients was 39 years [28]-[50]. More than half of our patients (53.7%) were in the 20 - 40 age group, which is similar to the data found in the African literature [6]. Many reports have shown a preponderance of ALA in male patients, who also tend to be younger (with a median age of around 20 - 40 years) than patients with PLA. [13]-[15] Among the clinical signs, jaundice remains the most important discriminating sign [16]. It is very common in pyogenic abscesses. However, in our study, we found other signs such as right basithoracic pain, fever, chills.

The markers of the non-specific biological inflammatory syndrome were higher in cases of PLA, in our study. However, according to Sifri et al., laboratory tests, such as leukocytosis (predominantly neutrophils), raised inflammatory markers (e.g. C-reactive protein), increased Alkaline phosphatase and abnormal liver function tests are often present but they have no real value in differentiating PLA versus ALA. [17].

Imaging techniques, such as ultrasonography and computed tomography (CT) scanning, are useful tools to demonstrate a space-occupying lesion and confirm presence or absence of a liver abscess. It may not reliably differentiate between PLA and ALA [18]. However, amoebic abscesses tend to be single and large in most cases [17], whereas bacterial abscesses may be single or multiple, ranging in size from a few millimeters to several centimeters. The preferred site for both types of abscesses remains the right liver [8].

In high-income countries, cause of liver abscess is usually determined using multiple diagnostic strategies, including blood cultures, *Entamoeba* serology and liver abscess aspirate for culture. Each of these individual options is challenged in the low- and middle-income countries setting. In low-income countries, pa-

tients generally present after initial unsuccessful antibiotic therapy, imaging reveals an abscess most often in the suppurated stage due to the long delay of diagnosis, and the cause may remain undifferentiated. Our study confirms this situation.

The color of the aspirate fluid may provide some preliminary information on the cause of the liver abscess. Traditionally, ALA is odorless, chocolate brown and thick, and commonly referred to as anchovy paste, while PLA is usually purulent and foul smelling. Although this may be helpful, its role in differentiation for the purpose of diagnosis remains uncertain. A bacterium is detected in 70 to 95% of cases of pyogenic abscess, providing a guide to antibiotic therapy. In the case of amoebic abscesses, the diagnosis is sometimes based on a suggestive clinical history, combined with the chocolate appearance of the pus, which is sterile on culture. In case of doubt, amoebic serology is a strong argument for the diagnosis.

Positive amebic serology can confirm the amoebic nature of the abscess, but PCR is considered the gold standard for patients living in endemic areas. However, this test is not always widely available in our context. In addition, the diagnostic value of amoebic serology in areas of high prevalence should only be considered informative in the case of high positivity, with a threshold of 1/160 [18]. In fact, antibodies may remain detectable for 6 to 12 months, making moderate serology positivity attributable to a previous infection [7] [8]. The test can also be falsely negative in case of acute presentations, patient's immune response, and the type of serologic test or the pathogen strain [19].

Fine needle aspiration for culture is the gold standard for diagnosis of PLA. This is not the case for ALA as parasite culture is insensitive and not routinely available in clinical laboratories. Microscopy also lacks sensitivity as trophozoites are seen in < 25% of cases [17].

It is recommended to perform a blood culture for any patient suspected of liver abscess on entry. They may provide helpful information in patients before they receive antimicrobials or aspiration of their abscess. Blood cultures are an important adjunct to the diagnosis of pyogenic abscess. But their yield is usually lower than pus aspirate of liver abscess, and the concordance between blood cultures and abscess aspiration cultures was less than 60% [2] [17]. This explains why it was not carried out in our study, as patients' limited financial resources, mean that bacteriological examination of abscess aspiration fluid is preferred.

Gram-negative bacilli (GNB) are implicated in 40% - 60% of cases of PLA, particularly enterobacteria (*Escherichia coli, Klebsiella pneumoniae*) and *Pseudomonas aeruginosa*. Anaerobic bacteria account for 35% - 45%, in particular *Bacteroides sp*. Gram-positive cocci, most frequently *Streptococcus sp., Staphylococcus sp*. and *Enterococcus sp* [1] [20] [21].

All of PLAs in our study were monomicrobial, and the most common bacterial isolates (found in roughly equal proportions) were *E. coli*, consistent with results from a number of other studies [22] [23].

Amoebic liver abscess can be treated medically, while pyogenic liver abscess usually needs to be percutaneously drained and treated with effective antibiotics [24].

In our context, antimicrobial guidelines generally recommend empiric therapy targeting both amoebic and pyogenic causes of liver abscess. ALA is managed medically, while PLA requires drainage and appropriate antimicrobial treatment. [25] [26]. Surgical drainage is usually reserved for complicated cases and has now been replaced by less invasive methods as the standard of care [26]. Despite improvements in diagnostic and therapeutic methods in recent years, the mortality rate of liver abscesses is still not negligible. It varies from 0 to 14% depending on the series [6]. Mortality rates from PLA have declined over time [27] [28]. Recent retrospective studies report mortalities between 0 and 13%, although length of follow-up varies and often only in-hospital mortality is reported [5] [10] [22] [29] [30]. In the literature, the mortality rate is higher in cases of pyogenic abscesses, especially those presenting complications [5] [29]. In our study, the occurrence of a complication is higher and the mortality was higher in cases of PLA.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Rossi, G., Lafont, E., Gasperini, L., Dokmak, S., Ronot, M., Rossi, B., *et al.* (2016) Abcès hépatiques. *La Revue de Médecine Interne*, **37**, 827-833. https://doi.org/10.1016/j.revmed.2016.08.009

[2] Chiche, L., Dargère, S., Le Pennec, V., Dufay, C. and Alkofer, B. (2008) Abcès à pyogènes du foie. Diagnostic et prise en charge. *Gastroentérologie Clinique et Biologique*, **32**, 1077-1091. https://doi.org/10.1016/j.gcb.2008.09.019

[3] Sharma, M.P. and Dasarathy, S. (1993) Amoebic Liver Abscess. *Tropical Gastroenterology*, **14**, 3-9.

[4] Ghosh, S., Sharma, S., Gadpayle, A.K., Gupta, H.K., Mahajan, R.K., Sahoo, R., *et al.* (2014) Clinical, Laboratory, and Management Profile in Patients of Liver Abscess from Northern India. *Journal of Tropical Medicine*, **2014**, Article 142382. https://doi.org/10.1155/2014/142382

[5] Pang, T.C. (2011) Pyogenic Liver Abscess: An Audit of 10 Years' Experience. *World Journal of Gastroenterology*, **17**, 1622-1630. https://doi.org/10.3748/wjg.v17.i12.1622

[6] Diallo, V.M.P.C., Déguénonvo, L.F., Manga, N.M., Ka, D., Diop, S.A., Seck, A., *et al.* (2018) Characteristics of Liver Abscess in Department of Infectious Diseases at Fann Teaching University Hospital in Dakar, Senegal. *Advances in Infectious Diseases*, **8**, 23-31. https://doi.org/10.4236/aid.2018.81004

[7] Sharma, S. and Ahuja, V. (2021) Liver Abscess: Complications and Treatment. *Clinical Liver Disease*, **18**, 122-126. https://doi.org/10.1002/cld.1128

[8] Soko, T.O., Ba, P.S., Carmoi, T. and Klotz, F. (2016) Amibiase (amoebose) hépa-

tique. *Hépatologie*, 1-9.

[9] Dieng, M., Diop, B., Konate, I., Ka, O., Dia, A. and Toure, C.T. (2007) Traitement des Abcès du foie: L'experience d'un service de chirurgie générale. Service de Chirurgie Générale et Digestive CHU Aristide Le Dantec-Dakar-Sénégal. *Médecine d'Afrique Noire*, **54**, 513-519.

[10] Su, Y., Lai, Y., Lin, Y. and Yeh, Y. (2010) Treatment and Prognosis of Pyogenic Liver Abscess. *International Journal of Emergency Medicine*, **3**, 381-384. https://doi.org/10.1007/s12245-010-0232-6

[11] Lardière-Deguelte, S., Ragot, E., Amroun, K., Piardi, T., Dokmak, S., Bruno, O., *et al.* (2015) Abcès hépatiques: Diagnostic et prise en charge. *Journal de Chirurgie Viscérale*, **152**, 233-246. https://doi.org/10.1016/j.jchirv.2014.09.011

[12] Sankale, M. (1978) L'abcès amibien du foie en milieu tropical. *Concours de Médecine*, **100**, 4365-4376.

[13] Neill, L., Edwards, F., Collin, S.M., Harrington, D., Wakerley, D., Rao, G.G., *et al.* (2019) Clinical Characteristics and Treatment Outcomes in a Cohort of Patients with Pyogenic and Amoebic Liver Abscess. *BMC Infectious Diseases*, **19**, Article No. 490. https://doi.org/10.1186/s12879-019-4127-8

[14] Meddings, L., Myers, R.P., Hubbard, J., Shaheen, A.A., Laupland, K.B., Dixon, E., *et al.* (2010) A Population-Based Study of Pyogenic Liver Abscesses in the United States: Incidence, Mortality, and Temporal Trends. *American Journal of Gastroenterology*, **105**, 117-124. https://doi.org/10.1038/ajg.2009.614

[15] Djossou, F., Malvy, D., Tamboura, M., Beylot, J., Lamouliatte, H., Longy-Boursier, M., *et al.* (2003) Abcès amibien du foie. Analyse de 20 observations et proposition d'un algorithme thérapeutique. *La Revue de Médecine Interne*, **24**, 97-106. https://doi.org/10.1016/s0248-8663(02)00015-2

[16] Cosme, A., Ojeda, E., Zamarreño, I., Bujanda, L., Garmendia, G., Echeverría, M.J., *et al.* (2010) Pyogenic versus Amoebic Liver Abscesses: A Comparative Clinical Study in a Series of 58 Patients. *Revista Española de Enfermedades Digestivas*, **102**, 90-99. https://doi.org/10.4321/s1130-01082010000200004

[17] Sifri, C.D. and Madoff, L.C. (2015) Infections of the Liver and Biliary System (Liver Abscess, Cholangitis, Cholecystitis). In: Bennett, J.E., Dolin, R. and Blaser, M.J., Eds., *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases*, Saunders, 960-968. https://doi.org/10.1016/b978-1-4557-4801-3.00077-1

[18] Haque, R., Mollah, N.U., Ali, I.K.M., Alam, K., Eubanks, A., Lyerly, D., *et al.* (2000) Diagnosis of Amebic Liver Abscess and Intestinal Infection with the Techlab Entamoeba Histolytica II Antigen Detection and Antibody Tests. *Journal of Clinical Microbiology*, **38**, 3235-3239. https://doi.org/10.1128/jcm.38.9.3235-3239.2000

[19] Otto, M., Gérôme, P., Rapp, C., Pavic, M., Vitry, T., Crevon, L., *et al.* (2013) False-Negative Serologies in Amebic Liver Abscess: Report of Two Cases. *Journal of Travel Medicine*, **20**, 131-133. https://doi.org/10.1111/jtm.12007

[20] Serraino, C., Elia, C., Bracco, C., Rinaldi, G., Pomero, F., Silvestri, A., *et al.* (2018) Characteristics and Management of Pyogenic Liver Abscess. *Medicine*, **97**, e0628. https://doi.org/10.1097/md.0000000000010628

[21] Brook, I. and Frazier, E.H. (1998) Microbiology of Liver and Spleen Abscesses. *Journal of Medical Microbiology*, **47**, 1075-1080. https://doi.org/10.1099/00222615-47-12-1075

[22] Lo, J.Z.W., Leow, J.J.J., Ng, P.L.F., Lee, H.Q., Mohd Noor, N.A., Low, J.K., *et al.* (2014) Predictors of Therapy Failure in a Series of 741 Adult Pyogenic Liver Ab-

scesses. *Journal of Hepato-Biliary-Pancreatic Sciences*, **22**, 156-165. https://doi.org/10.1002/jhbp.174

[23] Bosanko, N., Chauhan, A., Brookes, M., Moss, M. and Wilson, P. (2011) Presentations of Pyogenic Liver Abscess in One UK Centre over a 15-Year Period. *Journal of the Royal College of Physicians of Edinburgh*, **41**, 13-17. https://doi.org/10.4997/jrcpe.2011.104

[24] Khim, G., Em, S., Mo, S. and Townell, N. (2019) Liver Abscess: Diagnostic and Management Issues Found in the Low Resource Setting. *British Medical Bulletin*, **132**, 45-52. https://doi.org/10.1093/bmb/ldz032

[25] Rajak, C.L., Gupta, S., Jain, S., Chawla, Y., Gulati, M. and Suri, S. (1998) Percutaneous Treatment of Liver Abscesses: Needle Aspiration versus Catheter Drainage. *American Journal of Roentgenology*, **170**, 1035-1039. https://doi.org/10.2214/ajr.170.4.9530055

[26] Priyadarshi, R.N., Prakash, V., Anand, U., Kumar, P., Jha, A.K. and Kumar, R. (2018) Ultrasound-Guided Percutaneous Catheter Drainage of Various Types of Ruptured Amebic Liver Abscess: A Report of 117 Cases from a Highly Endemic Zone of India. *Abdominal Radiology*, **44**, 877-885. https://doi.org/10.1007/s00261-018-1810-y

[27] Huang, C., Pitt, H.A., Lipsett, P.A., Osterman, F.A., Lillemoe, K.D., Cameron, J.L., *et al.* (1996) Pyogenic Hepatic Abscess. *Annals of Surgery*, **223**, 600-609. https://doi.org/10.1097/00000658-199605000-00016

[28] Du, Z., Zhang, L., Lu, Q., Ren, Y., Lv, Y., Liu, X., *et al.* (2016) Clinical Charateristics and Outcome of Pyogenic Liver Abscess with Different Size: 15-Year Experience from a Single Center. *Scientific Reports*, **6**, Article No. 35890. https://doi.org/10.1038/srep35890

[29] Czerwonko, M.E., Huespe, P., Bertone, S., Pellegrini, P., Mazza, O., Pekolj, J., *et al.* (2016) Pyogenic Liver Abscess: Current Status and Predictive Factors for Recurrence and Mortality of First Episodes. *HPB*, **18**, 1023-1030. https://doi.org/10.1016/j.hpb.2016.09.001

[30] dos Santos-Rosa, O.M., Lunardelli, H.S. and Ribeiro-Junior, M.A.F. (2016) Pyogenic Liver Abscess: Diagnostic and Therapeutic Management. *Arquivos Brasileiros de Cirurgia Digestiva* (*São Paulo*), **29**, 194-197. https://doi.org/10.1590/0102-6720201600030015