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ORIGINAL ARTICLE

# Pyogenic liver abscess among children in a medical center in Central Taiwan



Yu-Lung Hsu, Hsiao-Chuan Lin, Ting-Yu Yen, Tsung-Hsueh Hsieh, Hsiu-Mei Wei, Kao-Pin Hwang\*

Division of Pediatric Infectious Diseases, Department of Pediatrics, China Medical University Hospital, China Medical University School of Medicine, Taichung, Taiwan

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## KEYWORDS

Children;  
*Klebsiella pneumoniae*;  
Pyogenic liver abscess;  
*Streptococcus* spp

**Background:** Pediatric pyogenic liver abscess is uncommon. This study aimed to investigate the clinical characteristics, radiologic features, pathogens, duration of hospitalization, and management of pediatric pyogenic liver abscess.

**Methods:** Pediatric patients with pyogenic liver abscess admitted to the China Medical University Hospital from 1995 to 2011 were reviewed. Their clinical characteristics, radiological features, laboratory data, clinical management, and outcomes were analyzed. Those with liver abscess due to the complication of oncologic disease were excluded.

**Results:** Fifteen patients were diagnosed with pyogenic liver abscess. Their most common symptoms were fever and abdominal pain. Eight (53.0%) had leukocytosis ( $>15000/\mu\text{L}$ ) and elevated C-reactive protein (CRP) level ( $>10\text{ mg/dL}$ ). The main imaging presentation was a single abscess in right lobe of the liver (13/15, 86.7%). Blood culture were mainly negative (12/15, 80.0%). Pathogenic microorganisms cultured from pus revealed *Klebsiella pneumoniae* (6/15, 40.0%) and *Streptococcus* spp. (6/15, 40.0%) as the two most common pathogens. Percutaneous abscess drainage followed by adequate parenteral antibiotics were effective interventions. Hospitalization of at least 2 weeks was needed in most cases. There were no mortalities.

**Conclusion:** Pyogenic liver abscess should be considered in children presenting with fever, abdominal pain, and leukocytosis with a high CRP level. Most cases involve a single lesion on right lobe of the liver. *K. pneumoniae* and *Streptococcus* spp. are the two most common pathogens. Drainage with adequate antibiotics has significantly good response.

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\* Corresponding author. #2, Yuh-Der Road, Taichung 404, Taiwan.  
E-mail address: [kapihw@mail.cmuh.org.tw](mailto:kapihw@mail.cmuh.org.tw) (K.-P. Hwang).

## Introduction

Pyogenic liver abscess (PLA) is an infrequent infection in children although majority (80%) of pediatric hepatic abscesses refers to pyogenic liver abscess, followed by amebic liver abscess.<sup>1</sup> The incidence of PLA is much higher among children in developing countries than those in developed countries. Incidence is reported to be one in 138 admissions in Brazil,<sup>2</sup> 78.9 per 100,000 admissions in South India,<sup>3</sup> down to 25 per 100,000 admissions in the United States of America.<sup>4</sup> In Taiwan, the incidence is between 8.9 and 20 per 100,000 pediatric admissions.<sup>5,6</sup>

*Staphylococcus aureus* is the most common isolated pathogen of pediatric PLA both in developed and developing countries.<sup>2,7</sup> In Taiwan, *Klebsiella pneumoniae* is recognized as the most frequent cause, both in adults and children.<sup>5,6,8</sup>

The gold standard of treatment remains debatable owing to the varying opinion on the modes of medical and surgical treatment. There is also less experience on PLA in children in Taiwan due to its low incidence. Thus, this study aimed to investigate the clinical characteristics, radiologic features, pathogens, duration of hospitalization, and management of pediatric PLA among children in central Taiwan.

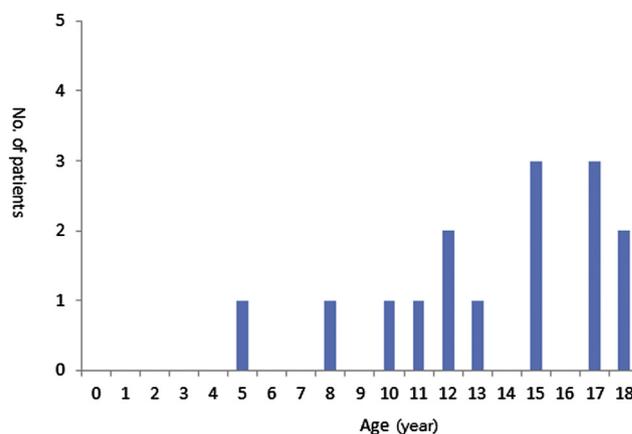
## Materials and methods

Fifteen children aged between 0 and 18 years old were admitted to the China Medical University Hospital with a diagnosis of pyogenic liver abscess from 1995 to 2011. All of the patients satisfied at least one of the following criteria: (1) Demonstration of intra-hepatic hypo-echoic or anechoic lesions on imaging that resolved with antibiotic treatment, and positive pus or blood culture; (2) positive percutaneous aspiration of purulent material from an intra-hepatic lesion; and (3) surgically-proven liver abscess.<sup>6</sup> Liver abscess due to complications of oncologic disease was excluded. Prolonged fever was defined as fever for 7 days or longer before the diagnosis of liver abscess.<sup>6</sup> The clinical characteristics, radiological features, laboratory data, clinical management, and outcome were analyzed.

## Results

During the 16-year study period, 15 children were diagnosed with PLA, including nine (60.0%) females and six males. Thirteen (86.7%) were older than 10 years of age (Fig. 1).

Six patients had associated comorbidities. Three had secondary liver abscess: two were related to acute appendicitis and one was from small intestine rupture. The other three patients had risk factors of liver abscess, including type 2 diabetes mellitus (DM) in two and type 1 DM in one. One of the two children with type 2 DM had comorbidity with thalassemia major, status post-splenectomy, and negative pus culture findings. *Klebsiella pneumoniae* was noted in the other two DM patients. Twelve patients (80%) were cryptogenic in origin, which meant primary liver abscess.



**Figure 1.** Age distribution of children with pyogenic liver abscess.

Fourteen children (93.3%) initially presented with fever. Seven (46.7%) suffered from prolonged fever. Abdominal pain was noted in 13 patients (86.7%), including five children with local tenderness on the right upper quadrant and three with tenderness on the epigastric area. Five patients (33.3%) complained of cough (Table 1).

Nine patients (60%) had leukocytosis ( $>15000/\mu\text{L}$ ), with an average of  $16353.3 \pm 5305.5/\mu\text{L}$ . Twelve patients (80%) had elevated C-reactive protein (CRP) level ( $>10\text{ mg/dL}$ ), with an average of  $19.2 \pm 11.7\text{ mg/dL}$ . Eight children (53%) had combined leukocytosis and elevated CRP. Increased serum glutamic pyruvic transaminase (GPT) was observed in six patients (50%) (Table 2).

All of the patients received either abdominal sonography or contrast-enhanced computed tomography (CT) scan. The sensitivity rate of these two imaging techniques for detecting liver abscess reached 100%. Thirteen children had a solitary abscess in the right lobe. The remaining two had multiple abscesses: one occupied the left lobe only, and the other implicated both lobes. The average diameter of the solitary liver abscess ( $n = 11$ ) was  $6.6 \pm 2.3\text{ cm}$  (range: 3.6–11.0 cm). For aspiration of the abscess, 12 patients had CT-guided percutaneous drainage regardless of liver abscess size, one had ultrasound-guided aspiration, and the patient with comorbid small intestine perforation had surgical intervention.

**Table 1** Clinical presentations of children with PLA ( $n = 15$ )

Clinical presentations	$n = 15$
Fever	14 (93.3%)
Prolonged fever	7 (46.7%)
Abdominal pain	13 (86.7%)
Right upper abdominal pain	5 (33.3%)
Cough	5 (33.3%)
Diarrhea	4 (26.7%)
Vomiting	2 (13.3%)
Body weight loss	2 (13.3%)

PLA = pyogenic liver abscess.

**Table 2** Laboratory findings of children with PLA ( $n = 15$ )

Laboratory findings	Data
WBC ( $n = 15$ )	$16353.3 \pm 5305.5$ / $\mu$ L
WBC $\geq 15,000$ / $\mu$ L	9/15 (60%)
CRP ( $n = 15$ )	$19.2 \pm 11.7$ mg/dL
CRP $\geq 10$ mg/dL	12/15 (80%)
GPT ( $n = 12$ )	$56.7 \pm 35.2$ IU/L
GPT $\geq 40$ IU/L	6/12 (50%)
GOT ( $n = 11$ )	$43.0 \pm 26.4$ IU/L
Culture findings	
Blood culture ( $n = 15$ )	3/15 (20%)
Pus culture ( $n = 14$ )	12/14 (85.7%)

CRP = C-reactive protein; GOT = glutamic oxaloacetic transaminase; GPT = glutamic pyruvic transaminase; PLA = pyogenic liver abscess; WBC = white blood cell.

Percutaneous abscess drainage (PAD) was performed within  $3.6 \pm 2.3$  (1-9) days after admission. Twelve patients had positive culture results from pus, while three had a positive blood culture (Table 2). The majority (12/15, 80.0%) of blood culture reports were negative (Table 2). Two children had positive pus and blood culture results, which revealed *K. pneumoniae*. *K. pneumoniae* (6/15, 40.0%) and *Streptococcus* spp. (6/15, 40.0%) were the two most common isolated microorganisms from pus. *Streptococcus* spp. included two isolates of *Streptococcus constellatus*, *Streptococcus intermedius*, and *Streptococcus viridans*, respectively. The other two pathogens were *Enterococcus faecalis* and *Escherichia coli* (Table 3). There was no difference in the distribution of *K. pneumoniae* and *Streptococcus* spp. among children with and without underlying disease. All strains of *Streptococcus* spp. were sensitive to penicillin, while strains of *K. pneumoniae* were all sensitive to amoxicillin/clavulanic acid, cefazolin, and cefotaxime.

All of the patients initially received antibiotic therapy. Based on the minimum inhibitory concentration test of blood or pus culture, the initial effective antibiotic usage was noted 10 patients. The total duration of antibiotic use was  $33.1 \pm 9.3$  days (range: 15-51 days). Parenteral antibiotics were used during admission for an average of

**Table 3** Bacterial isolates in children with PLA ( $n = 15$ )

Culture findings	
Blood culture	3/15
<i>Klebsiella pneumoniae</i>	2
<i>Pseudomonas aeruginosa</i>	1
Pus culture	12/14
Mixed infection	2/12
Single pathogens	10/12
<i>Klebsiella pneumoniae</i>	6/12
<i>Streptococcus</i> spp.	6/12
<i>Streptococcus constellatus</i>	2/6
<i>Streptococcus intermedius</i>	2/6
<i>Streptococcus viridans</i>	2/6
Others	2/12

PLA = pyogenic liver abscess.

$19.9 \pm 6.8$  days (range: 10-30 days). This was followed by oral antibiotics for an average of  $13.2 \pm 7.2$  days (range: 0-22 days).

Fever subsided  $5.1 \pm 4.2$  days after admission (range: 0-13 days). There was no mortality among the patients. All of the children were still alive after at least 1 year of follow-up.

## Discussion

There are several ways of developing pyogenic liver abscess, including bacterial entry into the liver via the biliary tract, portal vein, or hepatic artery. In the past, appendicitis has been considered the major associated condition of PLA.<sup>5</sup> Pathogens from the appendix go into the portal circulation and get trapped by the hepatic sinusoids to form a hepatic abscess.<sup>1,7</sup> Other conditions that contribute to PLA include cholangitis, trauma, systemic sepsis, infection of contiguous structures, ventriculoperitoneal shunt, and cryptogenic origins.<sup>5</sup> However, in the present study, most patients (12/15, 80%) had cryptogenic origins. This finding is similar to previous studies in northern (8/15, 53%) and southern Taiwan (11/15, 73%).<sup>5,6</sup> DM played a strong, potentially modifiable risk factor for PLA in Denmark over a 26-year case-control study.<sup>9</sup> In Taiwan, DM also caused a nine-fold increase in the incidence of PLA. In patients who had *Klebsiella* spp. liver abscess, 35% were associated with DM.<sup>8</sup> In another study, DM was also noted in 60.9% of adult patients with primary liver abscess caused by *K. pneumoniae*.<sup>10</sup> However, there was no difference in the distribution of *K. pneumoniae* and *Streptococcus* spp. among children with and without underlying disease.

Fever and abdominal pain were present in majority of patients in this study. Nearly half of them had prolonged fever (fever  $\geq 7$  days). Such clinical findings might be clues to finding liver abscess. About one-third of patients had cough, which might be due to stimulation of the diaphragm by the liver abscess. Thirteen of 15 children (86.7%) had solitary abscess in the right lobe. The preference of PLA in the right lobe could be related to differences in blood volume and blood flow direction to the common portal vein between the right and left portal veins.<sup>1</sup>

It is important to determine the pathogens from blood and pus culture. In this study, most pathogens were found from pus cultures. *Staphylococcus aureus* is the most common pathogen isolated from pediatric PLA both in developed and developing countries.<sup>2,7</sup> However, *K. pneumoniae* is recognized as the most frequent cause of pyogenic liver abscess in Taiwan, both in adults and children.<sup>5,6,8</sup> The most common secondary pathogen in central Taiwan is *Streptococcus* spp., which is different from previous studies in Taiwan.

In this study, all of the patients received antibiotics. Adjustments in antibiotics were based on results of susceptibility tests. Most of the patients received effective antibiotics initially, since the two most common pathogens were *K. pneumoniae* and *Streptococcus* spp. Hence, according to sensitivity studies, amoxicillin/clavulanic acid were used as first-line antibiotics even before proven report of culture. The patients received parenteral antibiotics for an average of 3 weeks, followed by oral antibiotics for another 2 weeks. The

treatment duration depended on the regression of the liver abscess, as noted by abdominal sonography or computed tomography. Percutaneous abscess drainage was the major management. There was no mortality in this study, which is lower compared to earlier reports.

In conclusion, pyogenic liver abscess must be considered in children who present with fever and abdominal pain and laboratory findings of leukocytosis and high CRP level. Abdominal sonography and computed tomography are useful diagnostic tools. *K. pneumoniae* and *Streptococcus* spp. are the two most common isolated pathogens in central Taiwan. Percutaneous abscess drainage combined with adequate antibiotics provides significantly good response.

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