Original Article

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Surgery Section

A Prospective Cohort Study of Catheter Drainage versus Percutaneous Needle Aspiration in Treatment of Liver Abscess

RK VINEETH KUMAR[1], ASHISH PRATAP SINGH[2], ASHISH SINGH[3], PRIYANK SHARMA[4]

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ABSTRACT

Introduction: India has second highest incidence of liver abscess worldwide. Image guided drainage methods are increasingly used to treat liver abscesses with fairly high success rates and with low cost and patient preference. But to choose a preferred one among these two methods of Percutaneous Catheter Drainage (PCD) and Percutaneous Needle Aspiration (PNA) still is a dilemma.

Aim: To compare the effectiveness and outcome of PCD and PNA in treatment of liver abscess.

Materials and Methods: A prospective cohort study was conducted on 150 liver abscess patients in Shyam Shah Medical College in Vindhya region Rewa, Madhya Pradesh, India, from June 2019 to May 2020. They were divided into two groups PNA (n=75) and PCD (n=75) by simple randomisation. Patient outcome was on the basis of duration to attain clinical relief (assessed subjectively), duration of hospital stay and days required for reduction in cavity size below 50%, death, and success rates were assessed in terms of number of attempts for adequate pus drainage. Chi-square test, non-paired Student's t-test and ANOVA tests were used.

Results: In this study mean age was 40.57 years with 92.67% males. Most common lobe to involved was right lobe (87.3%). *E.coli* was the most common organism. All patients in PCD group were successfully treated in a single attempt. PNA group had a success rate of 84%. Mean number of days of clinical improvement were less for PCD (mean was 5.27 days) than PNA group (mean was 7.49 days) p-value=0.002. Mean days required for reduction in cavity size to less than 50% was lower in PCD (mean was 7.20 days) than PNA group (mean was 8.75 days) p-value=0.01. Total duration of hospital stay was higher in PNA (mean was 11.59 days) than in PCD group (mean was 9.28 days) p-value=0.03. All multiloculated cavities in PNA group were failures.

Conclusion: PCD method was found to be more efficacious than needle aspiration method in this study.

Keywords: Abscess drainage, Amoebic liver abscess, Pyogenic liver abscess

INTRODUCTION

Liver abscess is a collection of purulent material within liver parenchyma. Amoebic liver abscess occurs more commonly on a worldwide basis and two third of amoebic liver abscess are found in developing countries, whereas the pyogenic liver abscess predominates in developed nations [1,2]. Previously surgical drainage was the most common method used but it was associated with significant mortality and morbidity [3].

Image guided placement of an indwelling catheter percutaneously is the most commonly preferred method to drain liver abscesses having the advantage being number of attempts are less, fast drainage, but catheter care poses some challenge and less patient preference. Although few studies have suggested needle aspiration to be a simpler and equally effective method of treatment with more patient preference, but incomplete evacuation and multiple attempts may be required sometimes thus producing the dilemma selection of procedure thus necessitating further studies [3,4].

With this background the present study was conducted to assess the relative effectiveness of either one of these two techniques which is being done by assessing parameters like success rate, days of clinical improvement, days of hospital stay. Clinical, laboratory and radiological {Ultrasonography (USG)} profile of liver abscess patients was also undertaken in this study.

MATERIALS AND METHODS

A prospective cohort study was conducted at Shyam Shah Medical College, Rewa, Madhya Pradhesh, India, from June 2019 to May 2020 in which all 150 confirmed cases by USG and/or Computed Tomography (CT) scans of liver abscess were included. This study was approved by the Institutional Ethical Committee (S.No:9405, 22/5/2019). Informed written consent was obtained from the participants and/or guardians or parents.

Inclusion criteria: Patients above 14 years of age, irrespective of sex, who attended the Outpatient Department and casualty at the Hospital and diagnosed to have liver abscess radiologically of >5 cm in size in at least one dimension or size more than 100 cc, liquefied and drainable were included in the study.

Exclusion criteria: All liver abscesses smaller than 5 cm in their greatest dimension or less than 100 cc were excluded from the study. Patients who have received prior intervention, ruptured liver abscess, concomitant biliary tract malignancy and uncorrectable coagulopathy, non-aspirable and thick abscess were also excluded. Hydatid cyst and cystic tumours were excluded from the study.

Study Procedure

In diagnostic dilemma with hydatid cyst during imaging USG, immunological (enzyme linked immunosorbent assay) tests were carried out. To avoid diagnostic confusion of cystic tumour, magnetic resonance imaging of the patient was performed.

They were divided into two groups for Percutaneous Needle Aspiration (PNA) and Percutaneous Catheter Drainage (PCD) by simple randomisation each with 75 cases. All the consenting patients were started on medical treatment as per hospital protocol {Intravenous (i.v) 3rd generation cephalosporins and metronidazole 2.4 gm/day}. Detailed clinical history and clinical investigation including complete blood count, prothrombin time, liver function test, blood culture, chest X-ray and abdomen including pus culture and sensitivity were taken. The USG with or without computed tomography scan (as per indication of patients) was done for all subjects fulfilling the inclusion criteria. Percutaneous procedures were carried out under local anaesthesia (2% lignocaine). Both aspiration and catheter drainage

was done under real time USG guidance. Repeat USGs was done as and when required and also after five days interval. follow-up was kept in all cases.

The criteria for successful intervention were taken as to allow resolution of infection by adequate drainage of abscess without the need for surgical drainage and discharge of patient from the hospital. Patient outcomes were recorded on the basis of duration of clinical improvement, duration of hospital stay, death, treatment success and failure rates.

The patients were discharged from hospital when infection subsided clinically, sonographic evidence of resolution of abscess like disappearance of abscess cavity or static cavity size with clinically infection subsided or decrease in size of abscess cavity (<50%).

STATISTICAL ANALYSIS

Statistical analysis was done by SPSS software (version 20). The chi-square test was used to analyse the success rates of the two treatment techniques. Unpaired Student's t-test was used to assess the statistical significance of differences in the time needed for clinical improvement, time required for 50% reduction in size of abscess cavity and time required for hospitalisation. The p-value of less than 0.05 was considered statistically significant with confidence interval of 95%. ANOVA test was done for treatment success rate with mean cavity size.

RESULTS

In present study, out of 150 liver abscess patients, there were patients ranging from lowest age of 19 years to highest age of 68 years. In the present study more than half of cases belonged to the age interval of 31 to 40 years (59.3%, n=89). Mean distribution of age was 40.57±9.18 [Table/Fig-1].

Age group (years)	No. of cases	Percentage (%)
Less than 21	1	0.7
21-30	12	8.0
31-40	89	59.3
41-50	23	15.3
51-60	21	14.0
Above 60	4	2.7
Total	150	100.0

[Table/Fig-1]: Age distribution in liver abscess patients.

Majority of cases 139 (92.67%) were males and 11 females (7.33%). History of alcohol intake was found in 127 cases (84.67%) and all were male patients. All the patients presented with a combination of various signs and symptoms. All the cases of liver abscess presented with abdominal pain followed by fever seen in 87.33% (n=131). Previous history of diarrhea was seen only in 20.67% (n=31) of the patients. Cough, a symptom of pleuropulmonary involvement was seen only in 34% (n=51) [Table/Fig-2].

Symptoms	No. of cases	Percentage (%)
Abdominal pain	150	100
Fever	131	87.33
Loss of appetite	72	48
Nausea and vomiting	64	42.67
Cough	51	34
Diarrhea	31	20.67

[Table/Fig-2]: Distribution of symptoms observed in the study group.

Most common clinical sign was right hypochondrial tenderness seen in 94% (n=141) followed by localised guarding [Table/Fig-3].

Average duration of illness was 3.11 weeks. In present study 98% (n=147) had low haemoglobin levels of value less than 13.5 gm/dL. About 84% (n=126) of the cases had leukocytosis. Eight patients

Signs	No. of cases	Percentage (%)
Right hypochondrial tenderness	141	94
Localised guarding	63	42
Hepatomegaly	44	29.33
Icterus	6	4

[Table/Fig-3]: Distribution of common clinical signs observed in the study group.

(5.33%) had total White Blood Cell (WBC) count more than that of 20,000/µL. Most common LFT abnormality was raised serum alkaline phosphatase levels found in about 92% of the cases (n=138). Rest of laboratory findings is given in [Table/Fig-4].

Abnormal liver function test	Normal range	No. of cases	Percentage (%)
Hypoalbuminemia	>3.4 g/dL	111	74
Raised serum alkaline phosphatase	<150 IU/L	138	92
Hyperbilirubinemia	<1.2 mg/dL	24	16
Raised aspartate aminotransferase	<40 IU/L	30	20
Raised alanine aminotransferase	<55 IU/L	27	18
Elevated prothrombin time	<13.5s	127	84.67

[Table/Fig-4]: Distribution of various abnormal liver function tests in the study group.

Average size of the cavity was 324.47 cc±132.77 Cavity size interval with most number of cases (n=23, 15.33%) belonged to between 211-230 cc followed by 231-250 cc (n=21, 14%) [Table/Fig-5]. Majority of the patients were found to have a single cavity (n=139, 92.66%). Two cavity liver abscesses was found in 9 cases (6%) and three cavities were found in 2 cases (1.3%). Multiloculations were seen in 19 cases (12.7%). Eight of them underwent percutaneous drainage and 11 had percutaneous aspiration requiring three or more attempts. Pus culture and sensitivity was done on all patients but found positive only in 22 cases (14.67%) [Table/Fig-6].

Class interval (cc)	Frequency	Percentage (%)
≤170	3	2.0
171-190 cc	13	8.7
191-210 cc	3	2.0
211-230 cc	23	15.3
231-250 cc	21	14.0
251-270 cc	6	4.0
271-290 cc	4	2.6
291-310 cc	12	8.0
311-330 cc	19	12.7
331-350 cc	9	6.0
371-390 cc	3	2.0
391-410 cc	9	6.0
411-430 cc	3	2.0
431-450 cc	1	0.7
451-470 cc	3	2.0
491-510 cc	3	2.0
551-570 cc	3	2.0
611-630 cc	6	4.0
631-650* cc	3	2.0
≥731 cc	3	2.0
Total	150	100

[Table/Fig-5]: Frequency distribution table for size of abscess cavity.
*No cases were present with cavity size between 650-730 cc

Total 75 patients underwent percutaneous aspiration and 75 patients percutaneous drainage. All the patients with percutaneous drainage had single attempt, whereas majority of aspiration patients required only single attempt (n=50, 66.67%), two attempts were required for 13 patients. Three or more attempts were considered as failure of intervention. One person required four aspiration attempts. Success

Culture result	No. of cases	Percentage (%)
Escherichia coli	9	40.91
Klebsiella sp.	7	31.82
Staphylococcus	2	9.09
Pseudomonas	2	9.09
Others	2	9.09

[Table/Fig-6]: Pus culture and sensitivity (Positive in 22 cases-14.67%).

rate in terms of attempts to evacuate pus were 98.67% for percutaneous drainage (one patient expired in this group due to complications of liver abscess: liver failure and septicaemia; unrelated to the procedure) and 84% for percutaneous aspiration. All the 11 cases with three attempts of aspiration had multiloculations [Table/Fig-7].

Number of attempts		Number of cases	Percentage (%)	Success rate
Percutaneous drainage	1	74*	98.67*	98.67%*
Percutaneous aspiration	1	50	66.67	84%
	2	13	17.33	
	3	11	14.67	
	4	1	1.33	
Total		149*	100	

[Table/Fig-7]: Attempts at aspiration and success rate.
*One patient was expired in this group due to complications unrelated to the procedure (liver failure and septicaemia)

Average cavity size for cases who had three and/or more attempts of aspiration done (failure) were 297.27±14.9cc and 430cc (one case) respectively with statistical significance of p value-0.02 and successful cases of aspiration had average cavity size less than above mentioned (256.87±7.4 cc).

In PNA group the mean cavity size of cases with treatment failure (299.09cc) was found to be higher than that of successful ones (242.11cc) with statistical significance (ANOVA test) p-value=0.001. Mean number of days for clinical improvement after intervention, mean number of days required for reduction in cavity size to less than 50% and total duration of hospital stay; 5.27 vs 7.49; 7.20 vs 8.75; 9.28 vs 11.59 days for PCD vs PNA respectively were found to be lower in PCD group than in PNA group [Table/Fig-8].

Characteristics		Treatment group		
		Needle aspiration	Catheter drainage	95% Confidence Interval (p-value)
Patient age (years)		41.1±8.57	40.1±9.83	0.002±
Gender	Male	70	69	0.003±
	Female	5	6	0.01±
Number of abscesses	Solitary	64	75	0.04±
	Multiple	11	0	0.034±
Location of abscesses	Right lobe	62	75	0.002±
	Left lobe	11	0	0.02±
	Both lobes	2	0	0.01±
Volume of abscesses (mean) cc		250.47±52.42	398.47±147.11	0.0005±
Multiloculations in cavity		n=11	n=8	0.006±
Duration of clinical improvement (days)		7.49	5.27	0.002±
Duration of hospital stay (days)		11.59	9.28	0.03±
Time for decrease in cavity size <50% (days)		8.75	7.2	0.01±
Mean cavity size (cc)	Treatment success	242.11 (n=63)	395.07 (n=74)	0.01¥
	Treatment failure	299.09 (n=12)	650 (n=1)	0.01¥

[Table/Fig-8]: Comparison of various characteristics between the Percutaneous Needle Aspiration (PNA) group and Percutaneous Catheter Drainage (PCD) group.
±Unpaired t-test was used
¥ANOVA test was used

DISCUSSION

In present study, majority of the cases belonged to the age interval of 31 to 40 years similar to what was obtained in study by Singh S et al., who had done a comparative study between both treatment methods in 60 patients [5]. Similar results were also obtained in study by Mukhopadhyaya M et al., whose majority of the cases belonged to the age group 31-40 years. Mean age was 40.57 years similar to other studies [6-8]. However, Giorgio A et al., reported average age in group of PLA as 45.3 years [8].

Majority of cases 139 (92.67%) were males and 11 cases (7.33%) were females similar to study by Ghosh S et al., but higher than that was found in other studies [5-7]. This also concurs with studies by Ahsan T et al., and Goh KL et al., and Cai YL et al., study [9-11]. This age predilection and gender differences may be as a result of high alcohol intake by young males which predisposes them to ALA [4].

In a study by Makkar RP et al., the liver iron was found to be significantly higher in patients with amoebic liver abscess, both alcoholic and non-alcoholic. Regular alcohol use was considered to be cause of higher liver iron in alcoholic ALA. Also, because of the regular menstrual blood loss, females belonging to reproductive age group are found to have lower iron stores. Low iron is unsuitable for the growth of *E. histolytica* [12].

History of alcohol intake was found in about 84.67% of the cases and all were males whereas in study by Mukhopadhyaya M et al., it was 61% [6]. Similar findings were also found in study by Seeto RK et al., in which they opined that alcohol being an immunosuppressant, impairs Kupffer cell function and suppresses cellular and humoral immunity [13].

Most common symptom was abdominal pain seen in all cases followed by fever in 87.33% and loss of appetite in 48% of the cases. In a study by Mangukiya DO et al., of 400 patients most common symptom was the same as that in our study [14], but second and third symptoms were high grade fever (74%) and, nausea and vomiting (50%) respectively. Previous history of diarrheoa was seen in 20.67% (n=31) of the patients which was higher than that seen in study by Singh S et al., but similar in Trivedi M et al., in which 20% had prior history of diarrhea [5,15]. Most common clinical sign was right hypochondrial tenderness with hepatomegaly seen in 94% of the cases. In Ghosh S et al., and Anjan AK et al., it was tender hepatomegaly in 89% and 95%, respectively similar to present study [7,16]. Localised guarding was the second most common clinical sign seen in 42% of the patients, similar to study by Mangukiya DO et al., which was also it's second most clinical sign seen in 47% [14]. Icterus was reported in 4% of cases less than that in Anjan AK et al., [16]. Cough a symptom of pleuro-pulmonary involvement was seen only in 34% of the cases and right-sided pleural effusion seen in 30 cases (20%) similar to Mukhyopadhya M et al., [6]. As expected in Indian population where anaemia is highly common, 98% of the study population had anaemia (Hb <13.5 gm/dL) and leukocytosis {About 84% (n=126)} similar to other studies [6,14].

Most common LFT found to be abnormal in our study was raised serum alkaline phosphatase levels seen in 92% of the cases (n=138) followed by elevated Prothrombin time found in 84.67% of the cases (n=127) followed by hypoalbuminemia in 74% of the cases. Similar results were found in other studies [5,14,17]. But in Ghosh S et al., it was low serum albumin levels [7]. Hyperbilirubinemia was seen in 16% of the cases in our study which concurs with other studies [5,7,18,19]. Various mechanisms for hyperbilirubinemia were suggested like pressure on biliary ducts (extra-hepatic obstruction) at or near the porta hepatis mainly by large abscess [20] and also by associated hepatitis or intrahepatic obstruction usually seen in large or multiple abscesses [21].

Most common lobe to be involved was right lobe seen in 137 cases (87.3%) which is in accordance with the findings of Sharma N

et al., Kebede A et al., Qazi A R et al., [19,21,22]. The reason being streaming effect in portal circulation where greater volume of blood goes to the right side than left as it is being supplied by superior mesenteric vein and also the biliary canaliculi are denser in right lobe leading to more congestion [23].

Multiloculations were seen only in 19 cases similar to Zerem E and Hadzic A [24]. Pus culture and sensitivity was positive only in 22 cases (14.67%). Most common organism found was *Escherichia coli* (n=9, 40.91%) followed by *Klebsiella* (n=7, 31.8%). Similar findings were obtained in Ghosh S et al., with 22% culture positive [7] and also in Singh S et al., with most common and second most common organism being *E.coli* and *Klebsiella pneumoniae* respectively in both the studies [5]. In Mangukiya DO et al., most common organism found was *Klebsiella sp* followed by *E. coli* [14] and in various other Asian studies [25,26].

All the patients with PCD didn't require any further attempts, whereas majority of the aspiration patients required only a single attempt (n=50, 66.67%). Three or more attempts were considered as failure of intervention. Rajak CL et al., compared PNA and PCD in which lack of response to a second attempt was considered failure of treatment which was done in present study [27] whereas Zerem E and Hadzic A considered third unsuccessful attempt as failure in treatment [24]. In PNA, we had a success rate of 84% after second attempt in comparison with PCD group with success rate of 98.67% where as in Rajak CL et al., series PNA was successful in 60% (n=15) of the 25 patients [27], higher success rate would likely have been achieved in case of multiple repeated aspirations but such multiple needle aspirations is a traumatic and unpleasant experience for the patients and may not be acceptable to majority of the patients.

The cases with multiloculations in cavity (n=19) of which 11 went for PNA resulting in failure whereas the rest of the eight cases who had PCD were successful in treatment. This finding concurs with that of Zerem E and Hadzic A in which PNA of all multiloculated abscesses failed [24]. Studies by Singh S et al., Bergert H et al., and Akinci D et al., considers continuous catheter drainage as a reliable and effective approach to the management of liver abscess [5,28,29]. But studies by Yu SC et al., and Thomas J et al., considers repeated PNA and PCD as equally effective and considers PNA as a first-line treatment option [30,31].

In our study, days required for clinical improvement and days for decrease in cavity size to less than 50% after intervention were found to be less for PCD group than that of PNA group. Total duration of hospital stay was found to be higher in PNA group than in PCD group which concurs with other studies [5,28,29]. Similar findings were also obtained in study by Zerem E and Hadzic A and Singh O et al., which agrees with our findings of PCD being more efficient than intermittent PNA [24,32]. In study by Kulhari M too all the three outcome measures favored PCD over PNA group [33]. The main strength of this study was its large sample size relative to that of other similar studies and the results of present study helps to contribute in answering the question of selection of procedure for first line management of liver abscess.

Limitation(s)

The patients in this study formed a heterogenous group including amoebic as well as pyogenic liver abscess and also by other causes. Aetiology of liver abscess was not evaluated in the present study. Most of the patients had been partially treated with antibiotics and then referred to our hospital, hence the probable reason for low culture positivity.

CONCLUSION(S)

In contrast to PNA, percutaneous placement of an indwelling catheter provides continuous drainage. All three outcome measures of this study (hospital stay duration, treatment success rate, and days for 50% reduction in cavity size) favored the PCD group. The probability of failure of PNA increases with the increase in size of abscess cavity to be aspirated where PCD is a good method for adequate drainage of large sized abscesses.

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PARTICULARS OF CONTRIBUTORS:
1. Resident, Department of General Surgery, Shyam Shah Medical College, Rewa, Madhya Pradesh, India.
2. Assistant Professor, Department of General Surgery, Shyam Shah Medical College, Rewa, Madhya Pradesh, India.
3. Senior Resident, Department of General Surgery, Shyam Shah Medical College, Rewa, Madhya Pradesh, India.
4. Professor, Department of General Surgery, Shyam Shah Medical College, Rewa, Madhya Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. RK Vineeth Kumar,
PG Boys Hostel, Room No. 10, Shyam Shah Medical College, Near SGMH,
Rewa-486001, Madhya Pradesh, India.
E-mail: vineeth.kumar.rk@gmail.com

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