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Original Research Article

Study on therapeutic effectiveness of laparoscopic drainage and image guided pigtail catheter drainage in the treatment of liver abscess: a randomised controlled trial

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ABSTRACT

Background: Liver abscess is one of the major diseases of gastrointestinal system. A liver abscess is a suppurative cavity in the liver resulting from the invasion and multiplication of microorganisms, entering directly from an injury through the blood vessels or by the way of the biliary ductal system. Liver abscesses are most commonly due to pyogenic, amoebic or mixed infections.
Methods: This is a randomised controlled trial to compare the outcomes of image guided pigtail catheter drainage and laparoscopic drainage in treatment of liver abscess. A total of 60 patients were recruited for the study and were divided into two groups between March 2017 to August 2018 with a follow up period of 6 months.
Results: Mean average pain score were significantly higher in image guided pigtail drainage group than in laparoscopic drainage group on 2nd, 5th and 7th day. The time taken for more than 50% resolution and for total resolution of abscess cavity size in the laparoscopic drainage group is significantly less than the time taken by the pigtail drainage group (p value <0.001). The average duration of hospital stay with pigtail catheter drainage is significantly higher (14.5±2.03) than the average duration of hospital stays with laparoscopic drainage (8.07±0.78).
Conclusions: We conclude that laparoscopic drainage of liver abscess is superior to image guided pigtail catheter drainage in terms of post-operative pain, hospital stay post procedure and resolution of abscess cavity.

Keywords: Amoebic liver abscess, Laparoscopic drainage, Liver abscess, Pigtail catheter drainage, Pyogenic liver abscess

INTRODUCTION

A liver abscess is a suppurative cavity in the liver resulting from the invasion and multiplication of microorganisms, entering directly from an injury through the blood vessels or by the way of the biliary ductal system.[1] Liver abscesses are most commonly due to pyogenic, amoebic or mixed infections. Less commonly these may be fungal in origin. Pyogenic liver abscess (PLA) may be defined as solitary or multiple collections of pus within the liver, the result of bacterial infection. PLA causes significant morbidity, mortality, and increased consumption of health care resources. The incidence of pyogenic liver abscess is rising in general population in the last few years. The severity of PLA depends on the source of infection and the underlying condition of the patient.[2]

Amoebic liver abscesses (ALAs) are common in tropical countries, mainly where "Entamoeba histolytica" is endemic and is more prevalent in young individuals with suppressed cell mediated immunity. The development of

ALAs is a serious complication of infection by *E. histolytica* and is the most common extraintestinal form of invasive amoebiasis. Indeed, an estimated 100,000 people succumb to ALA each year. Amebiasis is the third most common parasitic cause of death worldwide.[3]

Clinical presentation of liver abscess is non-specific and vary according to the patients underlying pathology. The common clinical features include fever with chills, abdominal pain, nausea, vomiting, diarrhoea, general malaise and anorexia. ALA mostly present with fever and abdominal pain and on abdominal examination there will be hepatomegaly with overlying muscle guarding and intercostal tenderness. Treatment options includes antibiotic therapy, USG guided needle aspiration with appropriate antibiotics, percutaneous catheter drainage, and laparoscopic or open surgical drainage.

At present advances in interventional radiology have enabled percutaneous interventions as the first line of treatment instead of surgery.

Although percutaneous placement of an indwelling catheter is the method most widely preferred to drain liver abscesses, it has its own disadvantages like prolonged hospital stay and catheter related complications. Placement of percutaneous catheter itself may cause bacteremia in spite of antibiotic administration and large multiloculated abscess is difficult to drain via percutaneous interventions. The overall failure rate of percutaneous catheter drainage is 15-36% and most often procedure have to be either repeated due to failure or supplemented with surgical approach.[4] Failure mostly occurs due to difficulty in access and inability to approach certain segments of liver such as caudate lobe abscess through percutaneous interventional techniques.[5] Further these abscesses are prone for major vascular or biliary complications.

Laparoscopic drainage offers excellent results in such cases and avoids the delay in treatment.[4] Laparoscopic drainage is highly useful in situations where percutaneous drainage is complicated leading to intraperitoneal rupture of abscess or bleeding from liver as it reduces the mortality and morbidity associated with open surgical drainage and is considered to be safe and effective in treating liver abscesses and recovery from symptoms is pronounced. Pigtail catheter drainage is one among standard surgical intervention in treatment of liver abscesses, however the efficacy of Pigtail catheter drainage in terms of treatment of multiple liver abscesses and problems related with catheter care and length of hospital stay were not clearly addressed. As there is dearth of literatures in Pigtail catheter drainage, this study was undertaken with the aim to compare the therapeutic effectiveness of image guided pigtail catheter drainage with laparoscopic drainage in the treatment of liver abscess.

METHODS

A randomized prospective interventional study was done to compare the outcomes of image guided pigtail catheter drainage and laparoscopic drainage in treatment of liver abscess for patients admitted between March 2017-August 2018 in SRM Institute of Science and Technology. Patients who were not fit for general anaesthesia, below the age of 18, pre-existing coagulopathy, ruptured liver abscess, and patients who underwent prior intervention were excluded from the study.

The study was commenced after obtaining approval from institutional ethical committee. The work has been reported in line with the STROCSS criteria. A total of 60 patients consented and fulfilled all the criteria and formed a part of the study. Patients were randomly allotted in two groups, Group A (Laparoscopic drainage) and Group B (Image guided pigtail catheter drainage). Patients after thorough clinical examination, routine blood investigations were done with liver function test and coagulation profile. Ultrasound and CT scan of abdomen was taken for all patients. All the patients were empirically started on Inj. metronidazole 750 mg IV TDS, Inj. cefazolin 1 g IV BD and Inj. gentamycin 80 mg IV BD and treatment was revised based on culture and sensitivity report.

Technique of pigtail catheter insertion

The standard pigtail external drainage catheter of size 16 or 18Fr composed of angio-graphic-type polyethylene tube was used in the study. The site and position of catheter insertion was determined by transabdominal sonography using 3.5-5 MHz transducer. A needle aspiration was done prior to pigtail catheter insertion. Local anaesthetic was injected over the marked site and a small stab puncture is made in the skin at the site of pigtail insertion. Pigtail catheter is inserted into the abscess cavity under ultrasound guidance and catheter was fixed to skin immediately after the procedure. The aspirated pus was sent for culture sensitivity and gram staining. Chest X-ray was done routinely after catheter drainage to rule out pleural effusion or pneumothorax. Catheter was flushed daily with 100ml of saline. Catheter output charting was done daily.

Laparoscopic drainage procedure

Under general anaesthesia, pneumoperitoneum was created using veress needle insufflation technique and a 10mm supra-umbilical trocar was inserted inside and general laparoscopy done. Additional two 5mm ports were introduced in the right and left subcostal planes depending on the site of abscess. Adhesions if present was released bluntly and liver exposed. Abscess cavity was opened bluntly by suction nozzle instrument and pus drained. Abscess cavity was irrigated thoroughly with normal saline and cleared of debris. A 28-size abdominal

drain was placed inside the cavity and fixed exteriorly to skin.

Evaluation of the response to the intervention

Pain score was measured using the Visual analogue scale (VAS) which was done by a trained staff at 2nd, 5th and at 7th day. Laboratory parameters- Serum bilirubin, total leukocyte count and serum alkaline phosphatase level was recorded in all patients on admission and compared with repeat values at 5th day and at 10th day post procedure. USG was done 2 days after the procedure to look for resolution in abscess cavity and serial follow up imaging was done. The total duration of hospital stay post procedure was noted and all the data was recorded and analysed.

In patients who underwent pigtail catheter drainage, besides recording the clinical and laboratory parameters, daily output of the catheter was measured and the catheter flushed with 50cc of normal saline. A decision to remove the pigtail catheter was made when the total drainage from catheter decreased to less than 10ml/24h for two consecutive days. In patients who underwent laparoscopic drainage, the abdominal drain was usually removed on confirmation of total/near total resolution of abscess cavity by imaging. Patients who are proven to have amoebic liver abscess received Tab. diloxanide furoate 500mg BD for 10 days at the time of discharge. All patients were followed up weekly for a month after discharge from hospital and monthly for next 3 months and at 6th month for clinical evaluation and USG assessment of abscess cavity.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Science (SPSS, version 17) for Microsoft windows. The data were not normally distributed. Non-parametric tests of significance were performed. Descriptive statistics were presented as numbers and percentages and Mean and SD. Mann Whitney test were used to compare continuous variables between two groups. Chi-square test was used for qualitative data. A two-sided p value <0.05 was considered statistically significant.

RESULTS

A total of 60 patients were included in the study, out of which 30 patients underwent laparoscopic drainage of liver abscess and 30 patients underwent image guided pigtail catheter drainage.

In this study, 18 patients in laparoscopic drainage group and 20 patients in pigtail drainage group, a total of 38 (63.4%) are in the age group of 41-60 years. Out of 60 patients in the study 44 patients (77.3%) are males and 16(27.7%) patients were females. Male: female is in the ratio of 3:1. Most of the patients (65%) had abscess located in the right lobe of liver, 16.7% (10) patients had abscess located in left lobe and 18.3% (11) patients had abscess located in both the lobes as shown in Table 1.

Table 1: Age distribution and location of abscess in both groups.

Variables	Group A	Group B
	N (%)	N (%)
Age (years)		
<40	1 (3.3)	1 (3.3)
41-50	8 (26.7)	11 (36.7)
51-60	10 (33.3)	9 (30.0)
>60	11 (36.7)	9 (30.0)
Gender		
Male	18 (60)	26(86.7)
Female	12 (40)	04(13.3)
Lobe of liver		
Right	19 (63.3)	20 (66.7)
Left	4 (13.0)	6 (20)
Both	7 (23.3)	4 (13.3)

Entamoeba histolytica was positive by amoebic serology test in 25% of patients, *E. coli* was grown in 12 patients (20%), culture was found to be negative in 11 patients (18.3%) and Pseudomonas and enterococcus was seen in 4 patients each. *Klebsiella pneumonia* was seen in 8 patients (13.3%). *Staphylococcus aureus* was found to be the causative organism in 5 patients (8.3%) and streptococcus was isolated in one patient (1.7%).

Table 2: Pain score (Mean ±SD) between two groups.

Pain score	Group A	Group B	P value by Mann Whitney test
At the end of 2nd day	3.87±0.81	5.72±0.59	0.000
At the end of 5th day	2.60±0.81	4.43±0.43	0.000
At 7th day	1.53±0.62	3.20±0.76	0.000

There is significant statistical difference in pain score on all days between both groups. Mean average pain score were significantly higher in image guided pigtail drainage group than in laparoscopic drainage group (p=0.000) as in Table 2. Table 4 reveals significant statistical difference between both groups in terms of improvement in serum bilirubin level from admission to 5th day with a 'p' value of 0.00, and it is concluded that improvement in serum bilirubin level is earlier when compared to image guided pigtail drainage group. The improvement in total leukocyte count at 5 days and 10 days post procedure is better in laparoscopic drainage group when compared to

image guided pigtail drainage. There is significant statistical difference between both groups (p<0.05). There is no significant statistical difference in ALP levels in both treatment groups on admission and at 5th day post procedure (p>0.05).

Table 3: Total bilirubin, total leucocyte count and serum ALP level on admission, 5th day and 10th day.

Variables	Group A	Group B
Total bilirubin level		
On admission	1.42±0.66	1.94±0.71
On 5th day	0.81±0.24	1.24±0.45
On 10thday	0.77±0.18	0.82±0.15
Total leukocyte count		
On admission	16413±4378	17774±4395
On 5th day	8996±2640	12323±3426
On 10th day	6996±1274	8920±2278
Serum ALP level		
On admission	190±85.08	201±87.96
On 5th day	109±48.60	123±52.68
On 10th day	81±19.36	86.17±16.94

Table 4: Comparing values of total bilirubin, total leukocyte count and serum ALP on admission with 5th day and 10th day among study groups.

Variable		Group A N (%)	Group B N (%)	P value by chi square test
Total bilirubin				
On admission	Normal	14 (46.7)	6 (20.0)	0.028
	Raised	16 (53.3)	24 (80.00)	
On 5th day	Normal	26 (86.7)	12 (40.00)	0.000
	Raised	4 (13.3)	18 (60.0)	
Total leukocyte count				
On admission	Normal	2 (6.7)	2 (6.7)	1.000
	Raised	28 (93.3)	28 (93.3)	
On 5th day	Normal	24 (80)	10 (33.3)	0.000
	Raised	6 (20)	20 (66.7)	
On 10th day	Normal	30 (100)	26 (86.7)	0.038
	Raised	0	4 (13.3)	
Serum ALP level				
On admission	Normal	12 (40)	10 (33.3)	0.29
	Raised	18 (60)	20 (66.7)	
On 5th day	Normal	26 (86.7)	22 (73.3)	0.197
	Raised	4 (13.3)	8 (26.7)	

Table 5: Summary statistics for time taken for more than 50% resolution and total resolution in abscess cavity size.

Variables	Group A	Group B	P value
Time taken for >50% resolution	3.27±0.45	7.33±1.21	0.000
Time taken for total resolution	6.93±0.69	13.53±2.03	

The time taken for more than 50% resolution and for total resolution of abscess cavity size in the laparoscopic drainage group is significantly less than the time taken by the pigtail drainage group (p- value <0.001). The average duration of hospital stay with pigtail catheter drainage is significantly higher (14.5±2.03) than the average duration of hospital stays with laparoscopic drainage (8.07±0.78). This difference in the average duration of hospital stay between the two groups was statistically significant (p<0.001). Patients were followed up over a period of 6 months. Out of 30 patients in Group A one patient (3.3%) developed recurrence, and out of 30 patients in image guided pigtail drainage group, 6 patients (20%) developed recurrent abscess.

DISCUSSION

This study findings show that laparoscopic drainage of liver abscess is superior to image guided pigtail catheter drainage in terms of post-operative pain, hospital stay post procedure and resolution of abscess cavity. In our study 38 out of 60-63.4% of patients were in the age group of 41-60 years, and the mean age in the study was 55.23 years. Ghosh et al in 2014 in his cross-sectional observational study on 200 liver abscess patients found that mean age of patient presented with liver abscess was 41 years.[6] Sepulveda B et al in his retrospective analysis with 150 patients from 2011 to 2015 on clinical manifestations of liver abscess have noted more prevalence of liver abscess in male patients compared to females.[7] In our study 73.3% of patients were males and 27.7% of patients were females and male: female was in the ratio of 3:1.

In our study 65% of patients had abscess located in the right lobe of liver, which is very similar to previous randomized controlled comparative study conducted by Singh S et al in 2013, who reported 78.4% of patients with right lobe liver abscesses.[8] Khan et al in his prospective randomized study series reported 68% of patients with amoebic, 21% pyogenic and 8 % with both types of liver abscess.[9] In our study we noted that there was predominance in bacterial abscess with 34 patients having blood culture positive-56.6%, and 25% of patients had amoebic liver abscess. Blood culture and amoebic serology was negative in 11 patients (18.3%) with indeterminate aetiology.

Dhamodharan et al in his study on 40 patients with liver abscess using laparoscopic drainage in the year 2018, concluded that laparoscopic drainage of liver abscess gives effective drainage with less hospital stay, less operative time and minimal post-operative pain.[10] In our study the mean pain score experienced by patients in laparoscopic drainage is very minimal when compared with patients in pigtail catheter drainage group. Ghosh et al in his study found that sepsis indicators like raise in total leukocyte count and low serum albumin level was noted in more than three fourth of patients. Jain V et al, in his study on correlation between abscess size and liver function test in cases of liver abscess in the year 2017, stated that abnormally high alkaline phosphatase levels were seen in 94% of cases and hyperbilirubinemia was seen in about 34% of cases.[11] In our study population we noted hyperbilirubinemia in 66.7% of patients, increase in total leukocyte count in 93.3% and raised serum ALP levels in 63.3%.

Rajak et al in the year 1997 on his study of 50 patients with liver abscess compared the clinical outcomes of needle aspiration versus percutaneous catheter drainage.[12] He concluded that there is no significant difference in average time taken for clinical relief and mean hospital stay in both groups. The average time taken for 50% reduction in abscess cavity size was 5 days with percutaneous catheter drainage, and 11 days with needle aspiration. He also found that time taken for total resolution of abscess cavity is similar in both groups. In our study, we noted that it took on an average 7.33 days for more than half reduction in abscess cavity with pigtail catheter drainage, while laparoscopic drainage took on an average 3.27 days. Romano et al in his retrospective study with 47 patients have found that most of their patients with liver abscesses who underwent laparoscopic liver abscess drainage have shown significant improvements within 7th post-operative day, in our study also we noted the same result with patients in laparoscopic drainage attaining significant improvement in terms of total resolution of abscess cavity within 6.93 days on average, while patients with pigtail catheter drainage took 14 days on average.[13] Wang et al in 2004 in his retrospective analysis compared patients who underwent laparoscopic drainage with open surgical drainage and concluded that patients who underwent laparoscopic drainage had less post-operative pain with shorter hospitalization.[14]

In our study, we noted that patients in laparoscopic drainage had lesser duration of hospital stay post procedure when compared to image guided pigtail drainage, it was 8 days on average with laparoscopic drainage and 15 days on average with image guided pigtail drainage. Yu et al in 2004 in their study comparing needle aspiration and pigtail catheter drainage, concluded that both procedures were safe and can be done with minimal complications.[15] In our study, there was no significant procedure related complications noted with image guided pigtail catheter drainage.

All the patients in our study groups were followed up for a period of 6 months and repeated clinical evaluation and ultrasound imaging was done. Recurrence of abscess was noted in 7 patients out of which 6 patients were from image guided pigtail drainage group. In these 6 patients, 4 required laparoscopic drainage subsequently and 2 were managed conservatively with antibiotics. One patient in laparoscopic drainage group developed recurrent abscess and was managed conservatively with antimicrobial treatment. Although we have found that laparoscopic drainage of liver abscess has more advantages when compared to pigtail catheter drainage, the cost effectiveness among two groups was not made out.

CONCLUSION

Laparoscopic drainage of liver abscess is a safer and potential alternative to image guided pigtail catheter drainage, and is the preferred method of choice in case of difficulty in approach to pigtail drainage, failed pigtail drainage and in case of residual or recurrent abscess. Further, improvement in laboratory parameters like serum bilirubin and total leukocyte count is more marked and earlier in laparoscopic drainage group than image guided pigtail drainage group.

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