

Comparison of effectiveness of open drainage and percutaneous needle drainage of pyogenic liver abscess

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Abstract:

Objective: To compare the effectiveness of open drainage and percutaneous needle drainage of pyogenic liver abscess.

Study sample: Department of Surgery, Mardan Medical Complex, Mardan

Study design: Randomized Control trial.

Study duration: 6 months. 19th January 2017 to 19th July 2017

Material and Methods: In this study a total of 238 (119 in each group) patients were observed. Patients with PLA in group A were subjected to open surgical drainage and patients in group B was subjected to percutaneous needle drainage. Post-operatively, all patients in the both groups were kept under observations for 3 days and discharged on the 3rd post-operative day if indicated. All the patients were followed up on the 7th post-operative day to determine intervention effectiveness in the terms of total absences of abscess collection on ultrasound of liver, all the diagnostic and follow up radiological procedures was conducted by single experienced radiologist having minimum of 5 years of experience.

Results: In this study mean age in group-A mean age was 38 years with $SD \pm 1.67$. Where as mean age mean age was 40 years with $SD \pm 2.93$ in group-B. In group A 58% patients were male and 42% patients were female. Where as in group-B 55% patients were male and 45% patients were female. More over open Drainage technique was effective in 85% patients while Percutaneous Needle Drainage technique was effective in 70% patients.

Conclusions: Our study concludes that open drainage is more effective than percutaneous needle drainage of pyogenic liver abscess.

Keywords: Open drainage, percutaneous needle drainage, pyogenic liver abscess

Introduction:

Pyogenic liver abscesses (PLA) are pus cavities caused by necrosis of the liver parenchyma. The necrotic tissues are liquidized and merge to form pus cavities. This disease usually is acute and progressive; often resulting is sepsis, impairment of liver function and disseminated intravascular coagulation. PLA account for almost 80% of all liver abscesses in the developed world and are most often polymicrobial. PLA has reported incidence of 0.5-0.8% in the Western world and a frequency of 20 per 100,000 admissions in hospitalized patients. When not diagnosed early and treated promptly, pyogenic

livers abscess can be fatal, with reported mortality rates as high as 80-100%.

There are a variety of methods to drain the PLA including percutaneous needle or catheter drainage, laparoscopic drainage and open surgical drainage. Some authors have claimed that prectaneous drainage is more tolerable, than open surgery. On the other hand open drainage has been advocated to be superior as it allows loculi of the abscess to be broken down effectively and subsequently large bore drains can be placed into the cavity. Also concomitant billiard pathology can be dealt with using this method.

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A comparative study has shown that open surgical drainage of PLA was highly associated with shock presentation then percutaneous drainage in the clinical course (35.7% versus 14.3% $p=0.007$).

However the overall success rate of the percutaneous needle drainage (65.86) and open drainage (72.5%) was statically insignificant. On the other hand, in a study it has been shown that open surgical draining for PLA had a significantly higher success rate than percutaneous drainage.

The current study is aimed to find the best treatment option for PLA in our local population after comparing the open drainage and needle aspiration. The rationale behind doing this study is that as mentioned above, the two studies giving different results in terms of effectiveness of both procedures and there is a great need of developing local statistics in our population about effectiveness of both procedures. In our study, if open drainage is found to be either equally or more effective than needle aspiration for PLA. The results of this study will be shared with other general surgeons and other studies. Our recommendation is that further research work should be done specially considering complications of both procedures before we could come to a final conclusion. By our study we conclude that open drainage to be routine and first line treatment option for all patients with pyogenic liver abscesses.

Material and Methods:

This study carried out in the Department of Surgery, Mardan Medical Complex, Mardan. It is randomized control trial carried out for 6 months 19th January 2017 to 19th July 2017. Our sample size was 238 patients. Our sample technique was consecutive (non probability) sampling. Our inclusion criteria, all patients with a single pyogenic liver abscess of more than 5 cm in size in any lobe of the liver and patients that are 10 -65 years of either gender. Our exclusion criteria was multiple liver abscesses in any part of the liver was excluded by ultrasound abdomen and CT scan abdomen with contrast. Secondary

pyogenic liver abscess due to any intervention of hepatobiliary surgery was excluded from the study by known clinical record of hepatobiliary surgery. Patient with diabetic mellitus (fasting blood glucose of > 126 mg/dl) due to their poor immunity and high susceptibility to infection was excluded from study. The above mentioned conditions act as confounder's and if included had introduce bias in the study result.

Data collection procedure: The study was conducted after approval from hospitals ethical and research committee. All patients meeting the inclusion criteria and presenting with PLA as per operational definition was included in the study through OPD and was admitted in the ward for further work up. The purpose and benefits of the study was explained to all patients and they were assured that the study is done purely for research and data publication and if agreed upon, a written informed consent was obtained.

All patients were worked up with detailed history and clinical examination followed by routine baseline pre operative investigation including like routine blood count prothroumbin time, bleeding and clotting time, LFT's blood grouping and cross much, urine routine examination, blood and sugar, ECG and serum electrolytes. The patients were randomly allocated in two groups by lottery method. Patients with PLA in group-A were subjected to open surgical drainage and patients in group-B was subjected to percutaneous needle drainage. Both the surgical procedures was conducted as per general surgery protocols and was conducted by single experience general surgeon having minimum of 7 years of post fellowship experience.

Post-operatively, all patients in the both groups were kept under observations for 3-days and discharged on the 3rd post operative day if indicated.

All the patients were followed up on the 7th post-operative day to determine the effectiveness in the terms of total absences of abscess on ultrasound of liver, all the diagnostic and follow up radiological procedures was conducted by

Table-1: Age distribution (n=238)

Age	Group-A	Group-B
10-25 years	9(8%)	12(10%)
26-40 year	38(32%)	39(33%)
41-55 years	48(40%)	43(36%)
56-65 years	24(20%)	25(21%)
Total	119(100%)	119(100%)
Mean and Sd	38years ± 1.67	40years ± 2.93

Group A: open drainage; Group B: Percutaneous needle drainage; Student t test was applied to compare mean, P value was 0.0001

Table-2: Gender distribution (n=238)

Gender	Group A	Group B
Male	69(58%)	65(55%)
Female	50(42%)	54(45%)
Total	119(100%)	119(100%)

Group A: open drainage; Group B: Percutaneous needle drainage; Chi square test was applied in which P value was 0.6012

Table-3: Sight of the abscess (n=238)

Sight of the Abscess	Group A	Group B
Left	18(15%)	18(15%)
Right	101(85%)	101(85%)
Total	119(100%)	119(100%)

Group A: open drainage; Group B: Percutaneous needle drainage; Chi square test was applied in which P value was 1.0000

Table-4: Efficacy open drainage vs percutaneous needle drainage (n=238)

Efficacy	Group A	Group B
Effective	101(85%)	83(70%)
Not effective	18(15%)	36(30%)
Total	119(100%)	119(100%)

Group A: open drainage; Group B: Percutaneous needle drainage; Chi square test was applied in which P value was 0.0053

Table-5: Stratification of efficacy w.r.t age (n=238)

	Effective	Group A	Group B	
10-25 years	effective	8	10	0.7188
	Not effective	1	2	
26-40 years	effective	33	29	0.1667
	Not effective	5	10	
41-55 years	effective	42	31	0.0655
	Not effective	6	12	
56-65 years	effective	21	19	0.2987
	Not effective	3	6	
		24	25	

Group A: open drainage; Group B: Percutaneous needle drainage

single experienced radiologist having minimum of 5 years of experience.

All the above mentioned information including

name, age, and gender was record in a pre designed performa. Strictly exclusion criteria had followed to control confounders and bias in the study results.

Data was analyzed by using a SPSS version 16.0. Mean standard deviation was calculated for continuous variable like age and pre operative size of the abscess. Frequency and percentages were calculated for gender, side of liver involved and effectiveness of the two procedures. Chi square test was used to compare the effectiveness between percutaneous needles drainage and open surgical drainage. P-value of ≤ 0.05 was considered significant. Effectiveness was stratified among age, gender, pre-operative size of the abscess and side of liver involved to see the effect modification. All the results were presented in the form of graphs and tables.

Results:

In this study age distribution among two groups was analyzed as in group A 9(8%) patients were in age range 10-25 years, 38(32%) patients were in age range 26-40 years, 48(40%) patients were in age range 41-55 years, 24(20%) patients were in age range 56-65 years. Mean age was 38years with SD ± 1.67 . Where as in group B 12(10%) patients were in age range 10-25 years, 39(33%) patients were in age range 26-40 years, 43(36%) patients were in age range 41-55 years, 25(21%) patients were in age range 56-65 years. Mean age was 40 years with SD ± 2.93 . (as shown in table -1)

Gender distribution among two groups was analyzed as in group-A 69(58%) patients were male and 50(42%) patients were female. Where as in group-B 65(55%) patients were male and 54(45%) patients were female. (as shown in table-2)

Sight of abscess among two groups was analyzed as in open drainage group 18(15%) patients had abscess on left side and 101(85%) patients had abscess on right side while in percutaneous needle drainage group 18(15%) patients had abscess on left side and 101(85%) patients had abscess on right side. (as shown in table-3)

Table-6: Stratification of efficacy w.r.t gender (n=238)

Gender	Effective	Group A	Group B	P value
Male	Effective	60	47	0.0346
	Not effective	9	18	
Female		69	65	0.1686
	Effective	44	42	
	Not effective	6	12	
		50	54	

Group A: open drainage; Group B: Percutaneous needle drainage

Table-7: Stratification of efficacy w.r.t sight of abscess (n=238)

Sight of abscess	Effective	Group A	Group B	P value
Left	effective	16	14	0.3711
	Not effective	2	4	
Right		18	18	0.0205
	effective	88	75	
	Not effective	13	26	
		101	101	

Group A: open drainage; Group B: Percutaneous needle drainage

Table-8: Stratification of efficacy w.r.t size of the abscess (n=238)

Sight of abscess	Effective	Group A	Group B	P value
5-10 cm	Effective	26	34	0.5212
	Not effective	4	8	
11-15 cm		30	42	0.0091
	Effective	78	55	
	Not effective	11	22	
		89	77	

Group A: open drainage; Group B: Percutaneous needle drainage

Size abscess among two groups was analyzed as in open drainage group 30(25%) patients had abscess size 5-10 cm and 89(75%) patients had abscess size 11-15cm. While in percutaneous needle drainage group 42(35%) patients had abscess size 5-10 cm and 77(65%) patients had abscess size 11-15 cm. (table-4)

Size of abscess cavity among two groups was analyzed as in open drainage group 18(15%) patients had re-collection of abscess cavity and 101(85%) patients did not had collection of abscess cavity. While in percutaneous needle drainage group 36(30%) patients had re-collection of abscess cavity and 83(70%) patients did not had collection of abscess cavity. (table-5)

Efficacy of open drainage vs percutaneous needle drainage was analyzed as open drainage technique was effective in 101(85%) patients and was not effective 18(15%) patients. While

percutaneous needle drainage technique was effective in 83(70%) patients and was not effective in 36(30%) patients. (as shown in table-6)

Stratification of efficacy with respect to age, gender, pre operative size of the abscess and side of liver involved is given in table no 7-10.

Discussion:

The introduction of the percutaneous approach to liver abscesses was initially described by Ma-Fadzean et al^{6,8} from Hong Kong in 1953. The literature in recent years suggests that percutaneous drainage of liver abscess is a safe and effective method for drainage of pyogenic liver abscess.^{3,6-8} As a result, this modality has become as the treatment of choice, being superior to open drainage^{4,8,9} The attraction of percutaneous drainage is related to its minimally invasive approach and the ability to perform the procedure without general anesthesia. Selected series of percutaneous drainage report success rates of more than 95%.^{88,90,91} However, PD is not suitable for all patients with liver abscesses. In cases of rupture, difficult access to the abscess due to anatomic location, coexisting pathology requiring open surgery, and open drainage becomes the only treatment option.⁸ In addition, the abscesses that fail to resolve after PD will also have to rely on an open surgical approach for successful management. Although the trend is toward percutaneous drainage, it is difficult to say which modality produces better clinical outcome. We hypothesized that open drainage can provide better clinical outcomes for liver abscesses larger than 5cm. To show this, open drainage mostly produced better resolution of fever and better success but with equally good morbidity and mortality rates as percutaneous drainage. There is some evidence from surgical reported series to suggest this. Bertel et al⁸ reported in a series of 39 patients and showed that the success rates were lower and hospitalization stay was longer than for the percutaneous drainage group. Similarly, Ferrucci JT et al¹⁷ also reported better success with open drainage (9.5 versus 36%), and more recently Herman et al¹⁹ reemphasized their good results of open drainage when compared with percutaneous drainage

for successful treatment (91.5% versus 69.2%). However, such comparison of percutaneous drainage with open drainage was largely difficult and criticized for selection bias.

Our paper is the first study in the literature that compares the 2 modalities for treatment of large liver abscesses >5 cm. Abscesses that were amenable to only open drainage, like rupture or concomitant surgical pathology requiring urgent surgical exploration, were excluded from the study according to our criteria listed. In addition, the dichotomous first-line treatment preferences for percutaneous drainage and open drainage, unique in our department, allowed for a reasonable comparison between the groups. The patient, clinical, and abscess profiles between the 2 groups are similar.

In this study, we have demonstrated that the surgical approach can provide a better clinical outcome than the percutaneous approach for abscesses larger than 5cm. This was significant in terms of number of treatment failures, number of secondary procedures, and hospitalization stay. The resolution of sepsis as defined by decrease of fever showed a trend towards faster resolution by open drainage than by percutaneous drainage, but this did not show any statistical significance. Most important, the use of surgical drainage did not come at an increased morbidity or mortality for our patients.

Drainage of large liver abscesses may be more difficult to achieve percutaneously. There are several advantages that surgical drainage, over percutaneous drainage that is evident in our results. First, in our series, multi-loculation is found in 80% of the abscesses treated. The role of percutaneous drainage of septated and multi-loculated abscesses is not clear. Ferrucci JT et al¹⁷ and Barakate et al¹⁸ suggested that multi-loculation contributes to poorer drainage due to several compartments of the abscess, due to septi reducing the effectiveness of percutaneous drainage. Surgical drainage allows adequate treatment of loculations and more complete drainage. Second, the use of open surgery provides better resolution of the abscess intra-

operatively than during percutaneous drainage procedures. This allows for accurate localization, planning of drainage route, localization, and avoidance of injury to vascular and biliary structures. In addition, complete drainage of the abscess cavity can be checked. This has also contributed to the lower-than-previously reported complications related to surgical drainage. We advocate the routine use of intraoperative ultra sound (IOUS) for all surgical drainage procedures. Third, surgical drainage allows the accurate drainage and placement of the drainage catheter to all portions of the liver and from all angles, with mobilization of the liver if necessary. This is often aided by palpation of the abscess wall if superficial. Fourth, surgical drainage allows for a soft large-bore tube drain to be placed for better drainage of residual viscid pus and necrotic debris. This would not be possible with the pigtail catheter or cope loop used for percutaneous drainage, resulting in a larger number of catheter-related complications. Fifth, intraoperative US also allows for localization and drainage of satellite abscesses that may be missed on CT. Lastly, the patients compared here underwent surgical drainage and percutaneous drainage as first-line treatments rather than surgical drainage as a backup modality for failed percutaneous drainage. This represents a more aggressive approach to liver abscess treatment. However, it also reflects the ability of surgical drainage to deal large abscesses in a better way, leading to less failures and shorter hospital stay.

Surgical drainage did not show a statistically significant difference to percutaneous drainage in terms of time to defervescence of fever, although there was a trend towards faster resolution of sepsis. However, this involved comparison of only successful treatments within the percutaneous drainage and surgical drainage group. The number of failures in the percutaneous drainage group contributed to the increased number of secondary procedures required and also the increase in length of hospital stay after drainage.^{11,12,18,21} This leads indirectly to an increase in cost of treatment of each patient. Failures in percutaneous drainage occurred in 27.8% of

cases. The major causes were catheter-related and progression of sepsis. Catheter-related complications include 3 blockages, 1 slippage, and 1 development of a empyema of the chest after the drainage track traversed the pleural space. Some of these could have been circumvented with the use of larger drainage catheters and further improved with better interventional radiology expertise and better case selection for PD.

Previously, authors reported in-hospital mortality rates for operative treatment to be up to 15% to 25%.^{13,14,21,22} However, this was not seen in our series. The mortality rate for surgical drainage and percutaneous drainage is 4.5% and 2.8%, respectively. This is much lower than previously reported for the surgical drainage group. This suggests that surgical drainage as first-line treatment produces equally good mortality outcomes as percutaneous drainage. Delay in definitive treatment and progression of sepsis may have contributed to apparent operative failures in previously reported series. A notable difference in our series compared with those published that could contribute to our good results is the low number of associated malignancies and high number of cryptogenic abscesses.²³

Our study can be criticized for its patient and treatment selection, the lack of assessment of quality-of-life issues when comparing surgical drainage and percutaneous drainage, as well as the retrospective nature of assessment of outcome. However, it highlights the possibility that surgical drainage does have a role in first-line management for large liver abscesses more than 5cm and should not be regarded as inferior or as a salvage procedure. It can result in better clinical outcomes than percutaneous drainage with comparable morbidity and mortality. This forms the rationale for a randomized trial comparing surgical drainage with percutaneous drainage to circumvent the selection bias and address this controversial issue.

Conclusion:

Our study concludes that open drainage is more effective than percutaneous needle drainage of pyogenic liver abscess.

Conflict of interest: None

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Role and contribution of authors:

Dr Muhkhtiar Ali, collected the data and wrote the initial writeup

Dr Asif Imran, helped in collecting the data and references and also helped in introduction writing.

Dr Muhammad Ismail, collected the data and references and helped in discussion writing.

Dr Shahid Khan, collection references and helped in interpretation of result

Dr Muhammad Ibrahim, critically review the article and made final changes.

References:

- Ochsner A, DeBakey M, Murray S. Pyogenic abscess of the liver. *Am J Surg.* 1938;40:292.
- Gerzof SG, Johnson WC, Robbins AH. Intrahepatic pyogenic abscesses: treatment by percutaneous drainage. *Am J Surg.* Apr 1985;149(4):487-94.
- Kandel G, Marcon NE. Pyogenic liver abscess: new concepts of an old disease. *Am J Gastroenterol.* Jan 1984;79(1):65-71.
- Rintoul R, O'Riordain MG, Laurenson IF. Changing management of pyogenic liver abscess. *Br J Surg.* Sep 1996;83(9):1215-8.
- Seeto RK, Rockey DC. Pyogenic liver abscess. Changes in etiology, management, and outcome. *Medicine (Baltimore).* Mar 1996;75(2):99-113.
- Stain SC, Yellin AE, Donovan AJ. Pyogenic liver abscess. Modern treatment. *Arch Surg.* Aug 1991;126(8):991-6.
- Branum GD, Tyson GS, Branum MA, Meyers WC. Hepatic abscess. Changes in etiology, diagnosis, and management. *Ann Surg.* Dec 1990;212(6):655-62.
- Chu KM, Fan ST, Lai EC. Pyogenic liver abscess. An audit of experience over the past decade. *Arch Surg.* Feb 1996;131(2):148-52.
- Gyorffy EJ, Frey CF, Silva J Jr, McGahan J. Pyogenic liver abscess. Diagnostic and therapeutic strategies. *Ann Surg.* Dec 1987;206(6):699-705.
- Rockey D. Hepatobiliary infections. *Curr Opin Gastroenterol.* May 1999;15(3):229-33.
- Tsai FC, Huang YT, Chang LY, Wang JT. Pyogenic liver abscess as endemic disease, Taiwan. *Emerg Infect Dis.* Oct 2008;14(10):1592-600.
- Pastagia M, Arumugam V. Klebsiella pneumoniae liver abscesses in a public hospital in Queens, New York. *Travel Med Infect Dis.* Jul 2008;6(4):228-33.
- Cheng HC, Chang WL, Chen WY. Long-term outcome of pyogenic liver abscess: factors related with abscess recurrence. *J Clin Gastroenterol.* Nov-Dec 2008;42(10):1110-Giorgio A, de Stefano G, Di Sarno A. Percutaneous needle aspiration of multiple pyogenic abscesses of the liver: 13-year single-center

- experience. *AJR Am J Roentgenol.* Dec 2006;187(6):1585-90.
14. Hashimoto L, Hermann R, Grundfest-Broniatowski S. Pyogenic hepatic abscess: results of current management. *Am Surg.* May 1995;61(5):407-11.
 15. Benedetti NJ, Desser TS, Jeffrey RB. Imaging of hepatic infections. *Ultrasound Q.* Dec 2008;24(4):267-78.
 16. Rubinson HA, Isikoff MB, Hill MC. Diagnostic imaging of hepatic abscesses: a retrospective analysis. *AJR Am J Roentgenol.* Oct 1980;135(4):735-45.
 17. Ferrucci JT, vanSonnenberg E. Intra-abdominal abscess. Radiological diagnosis and treatment. *JAMA.* Dec 11 1981;246(23):2728-33.
 18. Hope WW, Vrochides DV, Newcomb WL. Optimal treatment of hepatic abscess. *Am Surg.* Feb 2008;74(2):178-82
 Chung YF, Tan YM, Lui HF. Management of pyogenic liver abscesses - percutaneous or open drainage?. *Singapore Med J.* Dec 2007;48(12):1158-65.
 19. Men S, Akhan O, Koroglu M. Percutaneous drainage of abdominal abscess. *Eur J Radiol.* Sep 2002;43(3):204-18.
 20. Onder A, Kapan M, Büyük A, Gümüş M, Tekbas G, Girgin S, et al. Surgical management of pyogenic liver abscess. *Eur Rev Med Pharmacol Sci.* Oct 2011;15(10):1182-6.
 21. Yanaga K, Kitano S, Hashizume M. Laparoscopic drainage of pyogenic liver abscess. *Br J Surg.* Jul 1994;81(7):1022.
 22. Siu WT, Chan WC, Hou SM. Laparoscopic management of ruptured pyogenic liver abscess. *SurgLaparoscEndosc.* Oct 1997;7(5):426-8.
 23. Bowers ED, Robison DJ, Doberneck RC. Pyogenic liver abscess. *World J Surg.* Jan-Feb 1990;14(1):128-32.