

Ultrasound-guided Percutaneous Catheter Drainage in Liver Abscesses

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Objectives: To study the outcome and effectiveness of ultrasound-guided percutaneous catheter drainage in liver abscess.

Materials and Methods: This prospective study was conducted from 2017 to 2018. A total of 33 patients with liver abscess were treated with this method. Ultrasound and CT abdomen were done after clinical assessment for the initial size and localization of the abscess cavity. The percutaneous drainage with a 12-Fr pigtail catheter was done with the “trocar and cannula” method. Then, the cavity size was assessed every 2 days by the ultrasound. After removal of the catheter, the patients were assessed with ultrasound at the 2nd and 4th weeks. Hospital stay, cavity size reduction, and outcomes were studied.

Results: The study showed that patients were mainly aged between 31 and 40 (21.2%). Most patients were males (78.8%). In this study, amoebic abscess patients started to gain a 50% reduction in abscess cavity size after drainage at 4–28 days (11.45 days±7.46) whereas pyogenic abscess patients started at 6–28 days (12 days±10.71). The amoebic liver abscess group showed 2–9 days of hospital stay (4.45 days±1.79). Patients with pyogenic abscess had 3–6 days of hospital stay (4.75 days±1.5). One patient experienced localized peritonitis (3.4%) and 1 patient encountered a blocked catheter (3.4%).

Conclusion: This study highlighted Myanmar's clinical data of liver abscess and the results and outcomes of the percutaneous catheter drainage method for liver abscess treatment. Although this was a small sample size study, this method showed rapid improvement and good clinical outcomes.

Keywords: Liver abscess, PCD Percutaneous catheter drainage, Pigtail catheter, Ultrasound-guided

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INTRODUCTION

Liver abscess has been recognized since the time of Hippocrates (400 B.C). Because of its non-specific clinical features, relatively stable overall incidence and high morbidity and mortality if left untreated, it remains a formidable diagnostic and therapeutic problem [1].

Liver abscess is a common clinical problem in tropical countries and is most commonly caused by pyogenic, amoebic or mixed infections. Although the primary mode of treatment of amoebic liver abscess is medical, 15% of amoebic abscesses may be refractory to medical therapy. Also, secondary bacterial infection may

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complicate up to 20% of amoebic liver abscesses and hence drainage may be required in many patients with amoebic liver abscesses [2].

In patients with pyogenic and amoebic liver abscesses, a surgical drainage has been the traditional mode of treatment. However, the operative drainage is associated with significant (13%) mortality [3]. Over the last two decades, outcomes in patients presenting with liver abscess have improved as a result of advances in radiological diagnosis and percutaneous treatment options [4]. Currently, patients are treated with antibiotics along with percutaneous needle aspiration or percutaneous catheter drainage and surgical drainage is used only in patients who fail to respond to such treatment. Antibiotic therapy has also improved, but the principal advance in the management of hepatic abscess has been the application of percutaneous aspiration technique for diagnosis and treatment [5].

In Myanmar, the liver abscess is one of the most common problems in our surgical practice. Regarding admission data from three hospitals in Yangon (North Okkalapa Teaching and General Hospital, Thingangyun Sanpya General Hospital and Insein General Hospital), there were 130 cases of liver abscess admitted in 2013, 104 cases of liver abscess admitted in 2014 and recently 102 cases admitted in 2016 (Hospital admission data from North Okkalapa General and Teaching Hospital, Thingangyun Sanpya General Hospital and Insein General Hospital).

Generally, the choice of treatment and decision for drainage of the pus depend upon the site, size and number of abscess and complication developed. One randomized comparative study regarding two methods of percutaneous treatment was done at Mandalay General Hospital and submitted to University of Medicine, Mandalay [6]. With 50 randomized patients, the success rate in that study was 100% in both groups (needle aspiration group and percutaneous catheter drainage group). The catheter used in the percutaneous catheter group of this Mandalay study [6] was JMS infusion set with side holes (1 cm apart) and the method was 12-Fr trocar and cannula method for drainage. Another study regarding the outcome of ultrasound-guided indwelling catheter drainage of liver abscess was done in 2004 by Dr. Win Kyaw at University of Medicine – 1, Yangon [7]. Success rate was 100% with the treatment of ultrasound-guided indwelling catheter drainage in 48 patients with liver abscess. The catheter used in Dr. Win Kyaw study [7] was 7-Fr and the insertion method was Seldinger's technique with guide wire.

A meta-analysis compared the effectiveness of percutaneous needle aspiration and percutaneous

catheter drainage in the management of liver abscesses. It showed that percutaneous catheter drainage was more effective than needle aspiration. PCD is more effective than PNA because it facilitates a higher success rate, reduces the time required to achieve clinical relief and supports a 50% reduction in abscess cavity size [8].

Since 2004, there was no clinical data on percutaneous interventional treatment of liver abscess in Myanmar as the interventional radiology and real-time imaging methods are advancing more and more. With the availability of 12-Fr pigtail catheters on the Myanmar market, this study was done to evaluate the clinical data, outcomes, and effectiveness of ultrasound-guided percutaneous catheter drainage for treating liver abscesses in three general hospitals (secondary and tertiary levels) from Yangon, Myanmar.

MATERIALS AND METHODS

Study design, Study population and Study period

This study was a hospital based prospective study done within one year period after approval from ethical review committee of University of Medicine – 2, Yangon. Total patients of 33 from the surgical unit 1, unit 2 and unit 3 of North Okkalapa Teaching and General Hospital, surgical ward of Insein General Hospital and surgical ward of Thingangyun Sanpya General Hospital were enrolled for the study.

Sample size calculation

All liver abscesses admitted to three hospitals were included in the study. According to hospitals admission data from three hospitals, during 2016, liver abscess patients admitted to three hospitals were 102 and patients with liver abscess more than 5 cm in diameter was 87.

To check sample size adequacy, sample size determination by using proportion of success cases of liver abscess was computed from the study conducted in 2015 [8].

The following formula used to check the sample size.

$$n = \frac{Nz^2p(1-p)}{d^2(N-1)+z^2p(1-p)} \text{ (Daniel \& Cross, 2013) [9]}$$

According to the study done by Yu-Long Cai et al (2015) [8]

p = Proportion of success rate of percutaneous catheter drainage in patients with liver abscess (97%)

z = Standard normal distribution of alpha ($\alpha = 0.05$, $z = 1.96$)

d = Absolute precision = 0.05

N = Average available population size of patients with liver abscess more than 5 cm in diameter = 87 (Hospital record, 2016)

n = Minimum required sample size = 30

Therefore, minimum required sample size = 30

Adding drop-out rate 10% = $30 + 3 = 33$

Although an overall sample size required is 30, this is increased by 10% because there will be loss to follow up. The actual sample size required, therefore, becomes 33.

Sample size of at least 33 was needed for the study which was below the total patient with liver abscess who were admitted to three hospitals previous year.

Sampling procedure

The patients were examined by duty medical officers at the emergency department and outpatient department. The diagnosis of liver abscess was made clinically through history and physical examination and the diagnosis was confirmed by ultrasonographic examination. If the patients were within the inclusion criteria and no exclusion criteria, they were asked whether they want to participate in the study. CT abdomen was also requested. Those patients will be re-examined by the investigator after patients agreed to participate in the study to avoid the patient selection bias.

Inclusion and Exclusion criteria

All patients with liver abscess more than 5 cm were included. Hemodynamically unstable patients, patients with coagulopathy, technically difficult assess areas of liver abscess; abscess cavity with septations and multiple liver abscess, recurrent bacterial cholangitis and malignant disease of liver were excluded.

Method of drainage

A 12-Fr pigtail catheter was introduced into the abscess cavity by using the "Trocarr and Cannula" method. Under aseptic conditions and local anesthesia (1% lignocaine), diagnostic aspiration was first done to confirm pus and cavity and pus was sent to pathology (see Figure 1). This indicates depth and direction to assess liver abscess. Skin incision was made with No.11 blade. A 12-French Trocarr and cannula were inserted through the skin incision to abscess cavity under real-time ultrasound guidance. Pus was flushed out through the cannula when trocarr was removed. The catheter (12-French pigtail) was introduced into the abscess cavity through the cannula (see Figure 2). The cannula was removed after positioning the pigtail catheter. Aspiration was performed with the catheter till no pus from the

catheter. Abscess cavity was then irrigated with normal saline (0.9% sodium chloride). The catheter was secured to the skin with a 2-0 silk suture. The catheter was connected to a sterile collecting bag. And then, sterile dressing was applied over the catheter.

Immediately after procedure, the patients were kept under observation to detect any complications (see Figure 3). The followings were noted: Amount of pus aspirated (ml), color of pus (anchovy/yellow/other), and odor (foul smelling or not), thickness of pus (thick/thin), number of percutaneous catheters drain and duration of catheter drainage (days).

A sample of pus was routinely taken and sent for gram stain, culture, and antibiotic sensitivity test. The patients were assessed daily for clinical improvement and daily catheter output (ml in 24 hours) until they were discharged from the hospital. Patient outcomes, including the duration of hospital stay, procedure-related complications, treatment failure and death were recorded. Ultrasound examinations were done every two days during admission and at follow up to monitor the cavity size and complications of percutaneous treatment.

The catheter was removed when the patient is clinically improved, when the catheter output become serous or less than 10ml in 24 hours and reduced in size or collapse of the abscess cavity without any residual pus by ultrasound. All the patients were followed up and assessed clinically and by ultrasound imaging in the outpatient clinic for complications of percutaneous treatment and recurrence liver abscesses at two weeks and one month.

Outcomes and definitions

In this study, the following working definitions were used according to Kyaw Win Aung study [6]. Liver abscess is defined as a collection of infected fluid or pus in the liver. Percutaneous catheter drainage is defined as the placement of a catheter within the fluid collection followed by continuous drainage over time. A single abscess is diagnosed when there was one abscess area in the liver by ultrasonography or CT scan. Multiple abscesses are diagnosed when there was more than one abscess area in the liver by ultrasonography or CT scan. The patients will be discharged from the hospital when the infection has subsided clinically and there is sonographic evidence of abscess resolution such as disappearance of abscess cavity or static or decrease in size of the abscess cavity. Hospital stay is defined as duration of hospital admission after 1st time of percutaneous treatment. Mortality is defined as death within 30 days of treatment. Percutaneous drainage is considered to have failed if no improvement occurs if the

condition worsens within 72 hours of drainage or blockage of catheter drained. The criterion of successful percutaneous intervention is defined as adequate drainage of abscess to allow resolution of infection without the need for surgical drainage and with subsequent discharge of patient from the hospital.

Data analysis

Data management was checked by completeness, error, and inconsistencies prior to data entry. Data entry and analysis were done by SPSS 23 (Statistical package of social science) statistical software version 23. For the categorical data, number and percentage were calculated.

Ethical consideration

This was the hospital based comparative study of needle aspiration and percutaneous catheter drainage in liver abscess involving human subjects – patients with liver abscesses. The research protocol was submitted to the Academic Board and Ethics Review Committee of University of Medicine (2), Yangon and it was carried out only after getting approval of the Ethic Review Committee on 23rd June 2017.

All eligible participants according to the selection criteria for this study had the chance to participate in this study. They were thoroughly explained in detail about the research by the investigator with information sheet. Only after they have fully understood the nature of the study including aim and objectives, methodology, procedures, duration, risks, and benefits, they were invited to take part in the study. The participants were fully informed that the research data was used and published for the academic purposes - only in dissertation papers, in medical seminars and medical journals. The investigator strictly maintained the rules of privacy and confidentiality. The history taking, examination and the research works were done in places with proper privacy. No names were mentioned in this study. Only coded system was used, and research information was kept by a password-protected file in the investigator's personal computer. If they agree, the written informed consent was obtained.

The participation in the research was voluntary. The participants had the right to refuse to take part in the study and withdraw at any time from the study. There were acceptable risks to the participants for taking part in this study because both methods were standard treatments and with the benefits of rapid recovery or cure.

The participants were closely monitored throughout the research process. If any adverse reactions occurred,

the urgent treatment was given, and the necessary actions were taken according to the standard treatment procedure. No money, any forms of incentives and material goods were supplied to the participants by the investigator for taking part in this study.

RESULTS

In this study, total patients of 33 enrolled and there were no drop-out patients throughout the study. Most of the patients were age between 31 and 40 years (8 patients, 24.2%) followed by age between 41 and 50 years (7 patients, 21.2%). The mean age of the patients was 46.21 years (± 16.46). Out of 33 patients with liver abscess, 26 patients (78.8%) of the patients were male and the rest 7 patients (21.2%) were female. On ultrasound findings, liver abscess was found at right side in 31 patients (93.9%) and at left side in 2 patients (6.1%). Most of the patients got aspiration of pus amount of >500 ml (9 patients, 27.3%) followed by pus amount of 151-200 ml (7 patients, 21.2%). The mean pus amount of the patients was 394.24 ml.

Table 1. Age and Gender distribution of the study population.

Age	Number	Percentage
Age group		
21 – 30	6	18.2
31 – 40	8	24.2
41 – 50	7	21.2
51 – 60	4	12.1
61 – 70	4	12.1
>70	4	12.1
Age (years±SD, Min, Max)	46.21 ± 16.46, 25, 87	
Gender		
Male	26	78.8
Female	7	21.2

Out of 33 patients with liver abscess, 29 patients (87.88%) were sterile in pus culture. The rest 4 patients were 3 patients with *E. coli* (9.09%) and 1 patient with *Pseudomonas* species (3.03%). All the patients with amoebic liver abscess had 2-9 days of hospital stays (4.45 days \pm 1.79) whereas those with pyogenic liver abscess had 3-6 days of hospital stays (4.75 days \pm 1.5). Most of the patients with amoebic liver abscess had 50% reduction in abscess cavity after catheter drainage at day 6 whereas those with pyogenic liver abscess had also 50% reduction in abscess cavity after catheter drainage

at day 6. All the patients with amoebic liver abscess had 50% reduction in abscess cavity after catheter drainage at 4 – 28 days of hospital stays (11.45 days \pm 7.46) whereas those with pyogenic liver abscess had 50% reduction in abscess cavity after catheter drainage at 6 – 28 days of hospital stays (12 days \pm 10.71).

All patients with pyogenic liver abscess were discharged and cured. Out of 29 patients with amoebic liver abscess, 27 patients were discharged and cured (93.1%), 1 patient showed signs of localized peritonitis (3.4%) and 1 patient encountered with blocked catheter (3.4%). There was no mortality in both pyogenic and amoebic liver abscess.

Table 2. Outcome of percutaneous catheter drainage.

	Pyogenic Liver Abscess		Amoebic Liver Abscess	
	No.	Percent	No.	Percent
Discharge and Cured	4	100.0%	27	93.1%
Complications (Peritonitis)	0	0.0%	1	3.4%
Blocked Catheter	0	0.0%	1	3.4%
Mortality	0	0.0%	0	0.0%
Total	4	100.0%	29	100.0%

DISCUSSION

In a developing country like Myanmar, liver abscess is still a common problem in surgical wards. In recent years, there were changing trends in the treatment of liver abscess. Image guided percutaneous treatment methods have replaced the routine surgical intervention as a primary treatment for liver abscesses.

In general, the surgical drainage has been reserved for patients who fail to respond to treatment with percutaneous drainage and antibiotics or ruptured abscess cavity or who have concurrent intra-abdominal pathology which requires surgical management. Combination therapy with percutaneous drainage and antibiotics is indicated when the abscess is large and accessible [10].

In this study, age distribution of liver abscess showed that 24 percent of the study population was between 31 and 40 years. Second most common age group was between 41 and 50 years. Mean age of liver abscess patients in this study was 46 years. Regarding with the previous interventional studies of liver abscess in

Myanmar, Win-Kyaw study [7] described that the peak age incidence was 30-39 years age group for amoebic liver abscess and 40-49 years age group for pyogenic liver abscess. Another Myanmar study, Kyaw-Win-Aung [6], stated that the mean age incidence of liver abscess was 40 years for liver abscess patients in Myanmar.

Gender distribution of this study showed male patients (78.8 %) and female patients (21.2%). Ultrasound examination showed that abscess cavities were located at the right lobe of liver in 93.9% of patients in this study. These findings were also similar with previous Myanmar studies of liver abscess.

After imaging study with ultrasound, most of the liver abscesses were more than 500 ml (9 patients, 27.3%). The largest one in this study was 1800ml. In this study, maximum hospital stay after catheter drainage was 9 days for amoebic liver abscess and 6 days for pyogenic liver abscess. Previous study showed that the durations were 10-16 days for amoebic liver abscess and 11-15 days for pyogenic liver abscess [7]. His study did not mention whether it was the total length of hospital stay or days after catheter drainage. The study done in Mandalay region showed that duration of catheter drainage ranged from 4-7 days [6].

Patients were discharged after catheter removal in this study. No patients with catheter in situ were discharged. All the patients were treated with systemic antibiotic first before catheter drainage and so, clinically stable at the time of catheter drainage and after catheter removal. Patients with pyogenic liver abscess in this study were smaller cavity size than amoebic liver abscess before intervention and resolved faster than amoebic patients.

Out of 33 patients with liver abscess, 29 patients (87.88%) were sterile in pus culture. Three patients showed *E. coli* (9.09%) in culture and 1 patient with *Pseudomonas* species (3.03%).

Abscess cavity size was assessed for 50% reduction of cavity size. In pyogenic liver abscess, out of 4 patients, 2 patients gained the 50% reduction of cavity size at day 6 after catheter drainage. The rest showed cavity size reduction after that. Most of the patients with amoebic liver abscess also had 50% reduction in abscess cavity after catheter drainage at day 6. This study showed that amoebic liver abscess resolved 50 percent of cavity size within 4-28 days. Pyogenic liver abscess resolved 50 percent of its cavity size within 6-28 days after catheter drainage.

The outcome of this study was assessed with discharge from hospital, complications, and mortality. There was no mortality in this study. In this study, 31 patients were discharged and cured without

complications. One patient showed signs of localized peritonitis after catheter drainage and recovered with systemic antibiotics treatment and saline irrigation of abscess cavity. Another patient encountered blockage of catheter one day after insertion of catheter due to thick viscid nature of the pus and sludge from abscess cavity wall. Flushing with normal saline and ultrasound guided recheck of catheter position was done and these treatments solved the blockage. But none of these patients' hospital stay were prolonged and no complications at follow-up ultrasound examinations.

Serial ultrasound assessments were done to all patients every 2 days during catheter drainage and every 2 weeks for 1 month after discharge for response to treatment. Sonographic resolution of an abscess cavity following the procedure may occur at any time between 2 weeks to 4 months [11, 12].

Sumit Kapadia study showed small residual cavities may persist indefinitely and 40 percent of his patients had small residual cavities (<2 cm) at 3-month follow-up [13]. In Win-Kyaw study, most of the lesion disappeared on ultrasound examination at the end of third month in Myanmar patients [7].

The problems of failure in pigtail catheter drainage were reported by earlier studies [14, 15]. The causes were due to thick and viscid pus which cannot be easily drained by percutaneous catheter or early premature removal of the catheter. These problems can be avoided by using adequate size pigtail catheter depending on the viscosity of pus (5 Fr. to 12 Fr.) and following a strict protocol for flushing and removal. In this study, 12-Fr. pigtail catheter was used for all cases of liver abscesses. Another important factor for pigtail catheter drainage in Myanmar was the cost of the pigtail catheter. However, the advantages of the percutaneous drainage make the cost for the patient or for the hospital justifiable and cost-effective.

CONCLUSION

Changing trends of treatment in liver abscess are directed towards less invasive methods like percutaneous catheter drainage and needle aspiration and medical treatments. Moreover, easy availability of image guided treatment and serial monitoring and check-ups with ultrasonography also improve the treatment and outcome of liver abscess.

This study highlighted the prevalence of age, gender, clinical data and results of liver abscess and outcomes and complications of percutaneous catheter drainage method. Although this was a small sample size study with short duration, it showed rapid improvement

of percutaneous catheter drainage methods like 50 percent reduction in cavity size and hospital stays after catheter drainage.

As one of the less invasive methods, percutaneous catheter drainage has its own risks which need precautions. This study also highlighted these precautions to consider for further studies of liver abscess treatments. However, percutaneous catheter drainage method was not a cost-free method for the treatment of liver abscess. The cost of pigtail catheter and instruments were needed to consider for the patients of a developing country like Myanmar. But this study may suggest the cost-effectiveness of the percutaneous catheter drainage and duration of hospital stay in the treatment of liver abscess.

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Conflicts of Interest: The authors declare no conflict of interest.

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Ethical approval: The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of University of Medicine (2), Yangon, Myanmar.

Informed Consent Statement: Informed consents were obtained from all subjects involved in the study as well as to publish this paper.

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REFERENCES

1. Singh S, Chaudhary P, Saxena N, Khandelwal S, Poddar DD, Biswal UC. Treatment of liver abscess: prospective randomized comparison of catheter

- drainage and needle aspiration. *Ann Gastroenterol*. 2013;26(4):332-339.
2. Rajak CL, Gupta S, Jain S, Chawla Y, Gulati M, Suri S. Percutaneous treatment of liver abscesses: needle aspiration versus catheter drainage. *AJR Am J Roentgenol*. 1998 Apr;170(4):1035-9.
 3. Satiani B, Davidson ED. Hepatic abscesses: improvement in mortality with early diagnosis and treatment. *Am J Surg*. 1978 May;135(5):647-50.
 4. Huang CJ, Pitt HA, Lipsett PA, Osterman FA Jr, Lillemoe KD, Cameron JL, Zuidema GD. Pyogenic hepatic abscess. Changing trends over 42 years. *Ann Surg*. 1996 May;223(5):600-7.
 5. Wong KP. Percutaneous drainage of pyogenic liver abscesses. *World J Surg*. 1990 Jul-Aug;14(4):492-7.
 6. Kyaw WA. Comparative study of percutaneous catheter drainage and needle aspiration in the treatment of liver abscess [dissertation]. University of Medicine, Mandalay; 2004.
 7. Win K. The outcome of ultrasound-guided indwelling catheter drainage of liver abscess [dissertation]. University of Medicine (1) Yangon; 2004.
 8. Cai YL, Xiong XZ, Lu J, Cheng Y, Yang C, Lin YX, et al. Percutaneous needle aspiration versus catheter drainage in the management of liver abscess: a systematic review and meta-analysis. *HPB (Oxford)*. 2015 Mar;17(3): 195-201.
 9. Daniel, Wayne W., and Chad Lee Cross. *Biostatistics: A Foundation for Analysis in the Health Sciences*. Tenth edition. Hoboken, NJ: Wiley, 2013.
 10. Klink CD, Binnebösel M, Schmeding M, van Dam RM, Dejong CH, Junge K, et al. Video-assisted hepatic abscess debridement. *HPB (Oxford)*. 2015 Aug;17(8):732-5.
 11. Giorgio A, Tarantino L, Mariniello N, Francica G, Scala E, Amoroso P, et al. Pyogenic liver abscesses: 13 years of experience in percutaneous needle aspiration with US guidance. *Radiology*. 1995 Apr;195(1):122-4.
 12. Ralls PW, Quinn MF, Boswell WD Jr, Colletti PM, Radin DR, Halls J. Patterns of resolution in successfully treated hepatic amebic abscess: sonographic evaluation. *Radiology*. 1983 Nov;149(2):541-3.
 13. Sumit K, Duttaroy D, Ghodgaonkar P, Maru S. Percutaneous Catheter Drainage of Liver Abscesses. *Indian J Surg*. 2002; 64(6): 516-9.
 14. Bertel CK, van Heerden JA, Sheedy PF 2nd. Treatment of pyogenic hepatic abscesses. Surgical vs percutaneous drainage. *Arch Surg*. 1986 May;121(5):554-8.
 15. vanSonnenberg E, Mueller PR, Schiffman HR, Ferrucci JT Jr, Casola G, Simeone JF, et al. Intrahepatic amebic abscesses: indications for and results of percutaneous catheter drainage. *Radiology*. 1985 Sep;156(3):631-5.



Figure 1. Initial diagnostic needle aspiration to confirm pus and cavity depth

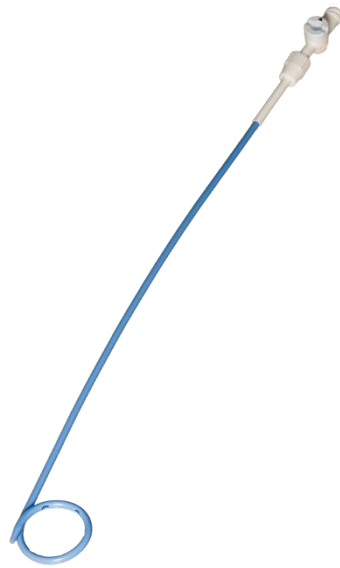


Figure 2. Pigtail Catheter used for liver abscess drainage



Figure 3. Pigtail catheter inserted into the liver abscess cavity