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Percutaneous Drainage of Hepatic Collections: Technique and Outcomes

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Abstract **Original Research Article**

Background: Hepatic collections, including abscesses, hematomas, and bilomas, represent a significant diagnostic and therapeutic challenge. Interventional radiology offers minimally invasive drainage techniques with high success rates and reduced procedural risk. ***Objectives:*** To evaluate the indications, techniques, and outcomes of percutaneous drainage of hepatic collections. ***Material and Methods:*** A retrospective study was conducted including 44 patients who underwent radiological drainage of hepatic collections at the University Hospital of Fès between 2022 and 2024. Data collected included drainage indications, techniques, drain type, complications, microbiological results, and patient outcomes. ***Results:*** The mean patient age was 56 years. Hepatic abscess was the most common indication [54.5%], followed by infected hydatid cyst [20.4%], biloma [18.3%], subcapsular hematoma [4.5%], and infected metastasis [2.3%]. Ultrasound-guided drainage was performed in 95% of cases. Complete regression was achieved in 79.5% of patients. Complications occurred in 16% of cases, including one case of septic shock and four drain dislodgments. ***Conclusion:*** Percutaneous drainage is a safe and effective first-line treatment for hepatic collections, with high success rates when combined with appropriate antibiotic therapy and multidisciplinary management.

Keywords: Hepatic abscess, Percutaneous drainage, Interventional radiology, Ultrasound guidance, Biloma, Hydatid cyst, Hepatic collection, CT-guided drainage.

INTRODUCTION

Hepatic collections, encompassing a diverse array of pathologies including abscesses, hematomas, and bilomas, present substantial diagnostic and therapeutic challenges. These collections may either remain aseptic and resolve spontaneously or manifest symptoms due to superinfection or compression of adjacent organs, necessitating surgical, radiological, or endoscopic drainage.

Interventional radiology has introduced minimally invasive guidance techniques, employing methods such as ultrasound or computed tomography, which have not only enhanced therapeutic success rates but also reduced the risks and complications associated with invasive procedures.

MATERIAL AND METHOD

This is a retrospective study including all patients who underwent radiological drainage of a hepatic collection at the university hospital of Fès [44 patients] during the period between 2022 and 2024. Collected data included the indications and methods of drainage, the type of drain used, incidents during and after the procedure, microbiological results, imaging characteristics of the collections, and patient outcomes. All our patients received well-conducted antibiotic treatment, imaging assessment with ultrasound and/or CT, biological assessment, and imaging follow-up.

DRAINAGE TECHNIQUE IMPLEMENTATION:

Perfoming percutaneous drainage of hepatic collections need a comprehensive approach, initiated by a multidisciplinary consensus, followed by patient informed consent. Subsequently, a stringent checklist is established to screen for any contraindications to the procedure.

The selection of the guidance modality should be individualized based on the patient's clinical condition, and the type, dimensions, and location of the hepatic collection. Ultrasound-guided drainage [Figure I] is generally favored for superficial and large

collections. Convex probes [3.5-5MHz] provide deep and wide exploration but compromise spatial resolution, while linear probes [7.5-10 MHz] offer superior spatial resolution but limited depth penetration.

The advantages of ultrasound-guided drainage encompass equipment accessibility, promptness, and absence of ionizing radiation. Furthermore, it facilitates real-time bedside drainage with multiple positioning planes. However, it is associated with limitations such as potential challenges in anatomical localization, interference from gastrointestinal gas, and difficulty visualizing highly echogenic material. [Kassimi *et al.,* 2014]

The merits of CT-guided drainage encompass precise anatomical localization and clear visualization of lesions and materials. Nevertheless, drawbacks include radiation exposure and prolonged procedure duration. [1]

Regarding the choice of drainage equipment, hydrophilic drains are the most frequently used as they facilitate tissue penetration. Drains with an 8 Fr size are employed for liquid collections, whereas 12-14 Fr drains are suitable for purulent collections. [1]

The drainage procedure is executed via a right subcostal approach [Figure II] and mandates stringent aseptic measures, safeguarding the guidance tool [e.g., ultrasound probe], peripheral venous access, preloading with isotonic saline, and preoperative antibiotic prophylaxis, typically comprising amoxicillin-clavulanate or clindamycin in conjunction with gentamicin.

This procedure starts with a localization examination via ultrasound or CT acquisition, with the patient positioned accordingly. This helps identifying structures at risk [vessels, bile ducts, gallbladder, pleural recesses, gastrointestinal interposition] and determining the optimal puncture site and trajectory. Subsequently, a sterile field and skin preparation with iodine-based solutions are sets up, local anesthesia is administered, and drainage is performed through direct puncture or the Seldinger technique [Table I].

Direct puncture drainage is a rapid and straightforward technique, reserved for experienced operators, straightforward access to the collection, and drain size less than 14 Fr for sufficiently voluminous collections. [Pelage, 2014]

The Seldinger-guided drainage, though more time-intensive and intricate, offers decreased trauma and enhanced precision. [Pelage, 2014]

Table I: Drainage According to Seldinger's Technique

Initial acces:	The initial approach involves the insertion of a fine needle [7 Fr] under image guidance. Aspiration of fluid or imaging confirmation ensures the correct positioning of the needle.
Guide Wire Insertion:	A flexible guide wire is introduced through the needle and positioned within the collection. The needle is then removed, leaving the guide wire in place.
Tract Dilation :	A dilator is passed over the guide wire to expand the puncture tract. This step may require the use of progressively larger dilators to adequately prepare the site for drain placement.
Drain Placement :	An appropriately sized drainage catheter is inserted along the guide wire and advanced into the collection.
Removal of Guide Wire and Dilator:	Once the drain is properly positioned, the guide wire and dilator are gently removed, leaving the drain in place.
Fixation and Drain Management :	The drain is secured to the skin to prevent accidental displacement. A bi- or tri-valve collecting system is then connected to allow fluid drainage.
Post-Procedure Control :	Follow-up images may be taken to confirm the drain's position.

After the drainage, the fluid collected must undergo microbiological examination. Maintenance of the drains is an integral part of percutaneous drainage and is also essential for a favorable outcome. [Pelage, 2014]

The drain is left in place until the collection is completely evacuated. In any case, the drain can be removed when the clinical and biological signs of infection have improved and the drain outputs less than 20 mL per day, [Tasu *et al.,* 2004] or after a satisfactory radiological check.

RESULTS

The study revealed that the mean age of the patients was 56 years, with an age range of 19 to 85 years. The most commonly affected age group was between 52 and 65 years, encompassing 15 patients, accounting for 34% of cases.

Regarding gender distribution, there was a slight female predominance, with a female-to-male ratio of 1.1.

For the indications for drainage, hepatic abscess was diagnosed in 24 patients, representing 54.5% of cases; biloma was identified in 8 patients, accounting for 18.3 %; infected hydatid cyst was observed in 9 patients,

comprising 20.4% of cases; subcapsular liver hematoma was noted in 2 patients, constituting 4.5% of cases; and infected hepatic metastasis was found in 1 patient, occurring in 2.3 % of cases.

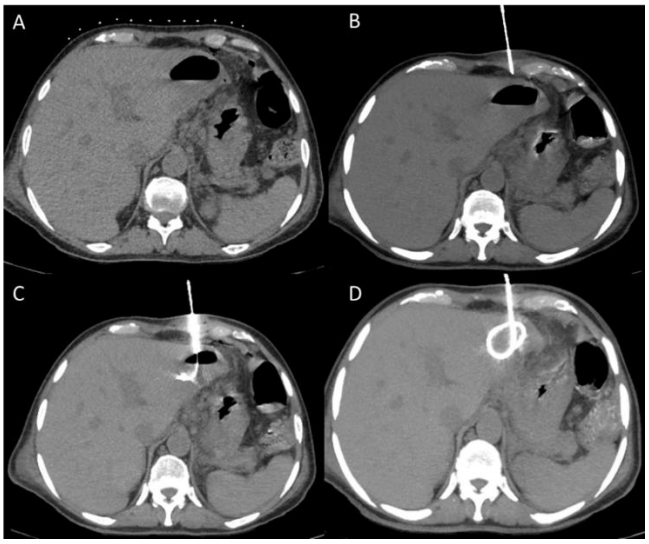

Figure I: Non-contrast abdominal CT performed during CT-guided drainage
A: Placement of anatomical landmarks. B: Introduction of the pigtail drain. C–D: Final positioning of the drain within the collection

In our series, the etiology of hepatic abscesses was predominantly of biliary origin. A cholecystitis, whether perforated or not, was identified in eight patients. Cholangitis was noted in three cases—two related to stones in the common bile duct [CBD], and one secondary to an ampullary tumor. Complicated appendicitis was responsible for hepatic abscess formation in two patients, and rectal diverticulitis was implicated in one case. One patient presented with a gastric tumor that had perforated and formed a fistulous tract to the liver. Another case was attributed to a pyonephrosis. In one patient with a history of breast cancer and prior hepatic metastasectomy, an abscess developed within the residual post-operative cavity. Finally, in two patients, a hepatic abscess occurred following laparoscopic cholecystectomy.

The majority of patients underwent radiologically guided drainage under ultrasound control. Specifically, 42 patients were treated with ultrasound-guided drainage, accounting for 95% of cases, with an average procedure duration of 20 minutes. Two patients underwent CT-guided drainage, comprising 5% of cases, with an average procedure duration of 40 minutes.

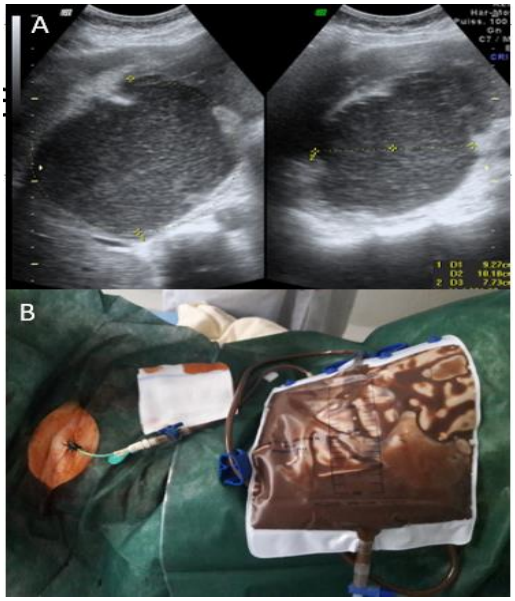

Figure II: A: Ultrasound-guided drainage of an amebic abscess. B: Drain in place connected to a collection bag containing "chocolate-colored" pus

Regarding the sizes of the drains used, 16 patients had 8 Fr drains, representing 36.5% of cases; 27 patients had 10 Fr drains, accounting for 61.3% of cases; and 1 patient had a 12 Fr drain, constituting 2.2% of cases.

As for incidents occurring during and after the procedure, a stage I allergic reaction was observed in one patient, who was successfully treated with corticosteroids. Another patient developed chills at the end of the procedure, subsequently progressing to septic shock with significant bacteremia, necessitating admission to the intensive care unit but ultimately recovering. One patient experienced hemodynamic instability during the procedure but responded well to immediate resuscitative measures. Four patients had accidental drain dislodgment in the days following the procedure, but they underwent successful redrainage and experienced good recovery. Finally, 37 patients, constituting 84% of cases, had uneventful procedures.

Cytobacteriological analysis of the drained fluid revealed superinfection by Gram-negative bacilli [E. Coli] in 8 cases, by Gram-negative bacilli [Klebsiella pneumoniae] in 7 cases, and by Gram-positive cocci such as Enterococcus faecalis in 3 cases, Staphylococcus aureus in 2 cases; by Klebsiella in 3 cases; by Gram-positive cocci: Staphylococcus aureus in 1 case; by Gram-negative bacilli: Proteus mirabilis in 1 case; by Gram-positive cocci: Acinetobacter baumannii in 1 case; by Gram-positive cocci: Streptococcus, beta-haem. Group C in 1 case; by Gram-positive cocci: Staphylococcus aureus in 1 case. Microorganisms was not found in the remaining 21 cases, as the patients were on antibiotic therapy.

Regarding the post-drainage evolution of hepatic collections, complete regression of the collections was observed in 35 patients, accounting for 79.5% of cases. In 6 patients, a second collection developed, occurring in 13.7% of cases, while 3 patients exhibited stable collections, representing 6.8% of cases. These patients subsequently underwent a second drainage procedure with favorable outcomes.

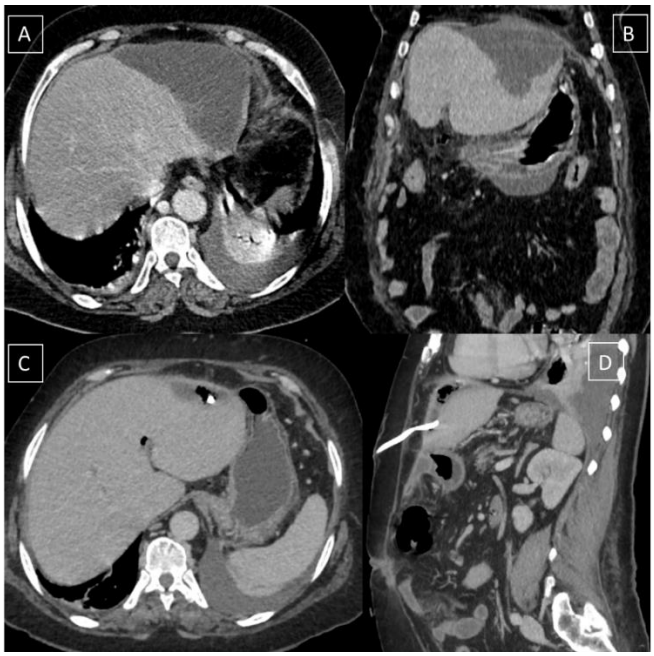

Figure III: A–B: Contrast-enhanced abdominal CT in axial [A] and coronal [B] views showing a large collection in the left liver lobe. C–D: Follow-up abdominal CT after drainage in axial [C] and sagittal [D] views demonstrating near-complete regression of the collection with the drain in place

Finally, the primary causes of drainage failure were multiloculated collections, dense pus, drain obstruction by hydatid cyst membranes in cases of infected hydatid cysts, and continuous feeding of the collections by extrahepatic collections.

DISCUSSION

A hepatic abscess [HA] can be defined as a suppurative cavity resulting from the invasion and proliferation of microorganisms within the hepatic parenchyma, whether it is in a healthy or compromised state. [Chiche *et al.,* 2008]

The etiology of HA may encompass bacterial, parasitic [primarily amoebic], mixed [pyogenic superinfection of parasitic elements], or, in rarer instances, fungal origins. [Nakanishi *et al.,* 2009] The principal causative factors for HA are succinctly summarized in Figure IV.

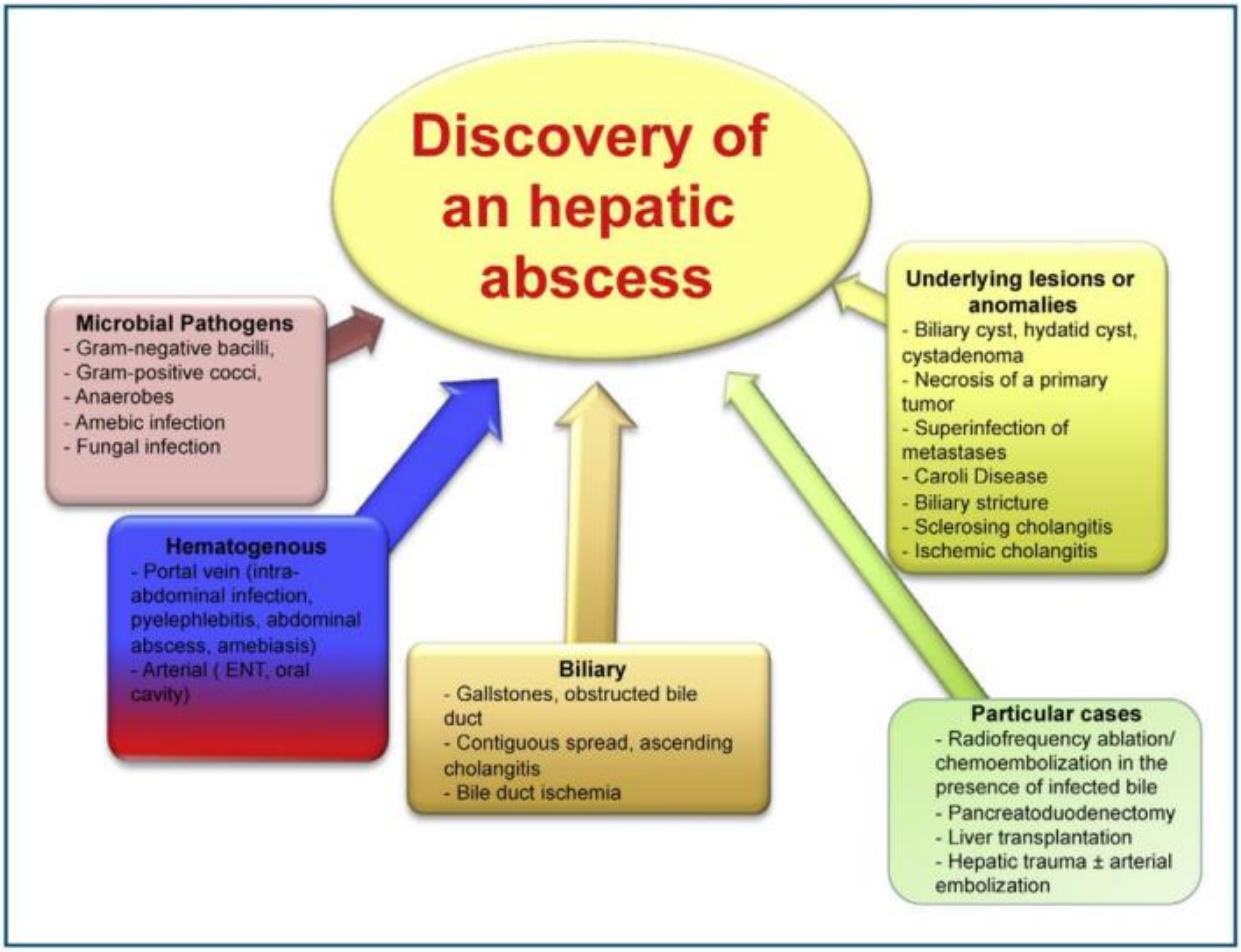

Figure IV: A schematic representation of the various etiologies to be considered when encountering a hepatic abscess. [6]

It is noteworthy that hydatid cysts may establish connections with the biliary tree, a phenomenon that can precipitate secondary superinfections and consequently lead to the development of abscesses within the cystic structure [Lardière-Deguelte *et al.,* 2015].

A biloma is an abnormal intrahepatic or perihepatic collection caused by the rupture of the biliary tract, whether traumatic, spontaneous, or iatrogenic.

In 1998, Rajak and colleagues published a randomized study comparing simple needle aspiration to catheter drainage of hepatic abscesses. In this study involving 50 patients with bacterial or amoebic abscesses, catheter drainage proved more effective than needle aspiration alone [success rates of 100% versus 60%].[Rajak *et al.,* 1998; Singh *et al.,* 2009]

The selection of percutaneous drainage as an intervention strategy hinges upon the anatomical localization of the collection. This approach can prove to be efficacious for patient management or as a preparatory step for secondary interventions. Thorough pre-drainage evaluation is important in reducing the risk of complications, and meticulous adherence to hepatic anatomy is imperative

As pertains to abscessed collections, percutaneous drainage is indicated for cases involving infected hepatic hydatid cysts, infected hematomas, and hepatic abscesses exceeding a diameter of 5 cm, or when sepsis persists despite 48 to 72 hours of appropriate intravenous antibiotic therapy. [Chiche *et al.,* 2008]

Bilomas carry a risk of superinfection, warranting their preferential drainage via percutaneous techniques guided by either ultrasound or computed tomography.

The pre-procedural safety checklist before percutaneous drainage of a hepatic collection includes the following criteria: a platelet count above 50,000/mm³, a prothrombin time [PT] greater than 50%, and an activated partial thromboplastin time [aPTT] less than 1.5 times the normal value. Anticoagulant therapy should be discontinued appropriately prior to the procedure: at least 48 hours for vitamin K antagonists [VKA], at least 12 to 24 hours for low molecular weight heparin [LMWH] depending on dosing, and 3 to 5 days for antiplatelet agents when the aspirin dosage exceeds 160 mg/day. [Patel *et al.,* 2019; Douketis *et al.,* 2012; Veitch *et al.,* 2016]

The contraindications for percutaneous drainage of hepatic collections include severe coagulopathy, hazardous or impossible percutaneous access, patient non-compliance, or rupture [Kassimi *et al.,* 2014] or fistulization of the collections with the peritoneum.

Limitations include collections situated in anatomically challenging locations, such as the hepatic dome or deep abscesses, multiloculated forms, as well as collections consisting of viscous pus and necrotic debris that cannot be adequately evacuated due to catheter size constraints [Chiche *et al.,* 2008].

Procedural complications may encompass collection rupture, pleural contamination via transpleural pathways, the development of subcapsular hematomas, and localized pain along the drainage trajectory. [4]

Post-procedural complications commonly include recurrent formation of the previously drained collection, inadvertent drain dislodgment, or drain occlusion. [1]

In light of our experience in managing hepatic collections, we recommend adapting the frequency of flushes to the nature of the collection's contents: the thickness the collection, the more frequent the flushes should be done. Direct aspiration should be avoided to prevent parietal collapse and obstruction of the drain's openings by debris. Irrigations should be performed vigorously by injecting 20 to 50 ml of normal saline, while protecting the stopcock in order not to contaminate the drainage system by nosocomial pathogens. In cases of loculated collections, placement of an others drains [2, 3..] via a second approach may be necessary depending on the volume of the collection. Regular irrigation helps shorten the duration of drain placement and hospital stay. Intrahepatic or subcapsular hepatic hematomas should not be drained during the acute phase, but rather only if they become infected

We recommend also a prophylactic heparin therapy 24 hours after drainage in order to prevent septic thrombosis of the portal and suprahepatic veins

CONCLUSION

Percutaneous drainage is the first-line treatment for hepatic abscesses with a liquid component larger than 5 cm or in cases of severe sepsis. The principle involves puncturing, evacuating the cavity, and establishing external drainage under the guidance of ultrasound or computed tomography.

The effectiveness of percutaneous drainage is optimized through prompt intervention, careful follow-up after drain placement, and a multidisciplinary approach to patient care.

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