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Ultrasound Guided Drainage and Aspiration of Intra-Abdominal Fluid Collections

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Abstract

Background: Currently, ultrasound-guided percutaneous biopsies, abdominal abscesses evacuation, cyst and fluid aspiration are standard diagnostic techniques. This research purposed to clarify role of ultrasound guided evacuation and intra-abdominal fluid collections aspiration.Methods: This cohort prospective research was conducted on 50 intra-abdominal fluid collections individuals who had ultrasound-guided percutaneous evacuation. The collections were discovered and targeted by ultrasound or guided percutaneous needle aspiration, and a safe evacuation path that protected key anatomic structures was devised. All participants underwent exhaustive patient history, clinical and general examinations and lab investigations and radio diagnostic imaging.Results: Regarding the location of collection, it was intraperitoneal in 33(66%) patients and retroperitoneal in 17(34%). The nature of collection was liver abscess in 25(50%) patients, peripancreatic collection in 10 (20%) patients, GB perforation in 8 (16%) patients and appendicular abscess in 7 (14%) patients. Nature of fluid was unilocular in 26 (52%) patients and multilocular in 24 (48%) patients. The volume drainage ranged from 476-775 ml with a mean of 622.74±84.39 ml. Catheter was the treatment option in 29 (58%) patients and Puncture was the treatment option in 21(42%) patients. The hospital stay was with a median of 2.5 days.Conclusions: US-guided evacuation is an effective treatment for intra-abdominal collections and has become the therapeutic option for a broad range of intra-abdominal collections. It is advantageous to avoid or postpone a big operation.

Keywords: Ultrasound-Guided; Drainage; Aspiration and Intra-Abdominal Fluid Collections.

1. Introduction

Currently, ultrasound-guided percutaneous biopsies, evacuation of abdominal abscesses, and aspiration of cyst and fluid are standard diagnostic techniques. It is an efficient, safe, and generally acknowledged cost-effective procedure for the treatment of solid or cystic masses situated superficially or deeply [1].

Ultrasonography is recommended for guided operations since portable machines are available. It is reasonably priced and emits no ionizing radiation. Real-time ultrasonography enables guidance in several planes, i.e., longitudinal, transverse or oblique. The largest benefit is the real-time viewing of needle entry via tissue planes while evading critical intervening arterial systems. It is possible to prevent puncturing major blood arteries such as the inferior vena cava and portal vein using color Doppler [2].

Ascites, blood, pus, bile, urine, lymph, cerebral spinal fluid (CSF), and mucus are some of the fluids that may collect in the peritoneal and pelvic spaces. The presence of certain of these fluids on computed tomography (CT) may imply a particular origin, but in the majority of instances, a diagnostic aspiration must be done [3].

Free intraperitoneal fluid and confined fluid collections are the two primary classifications of intraabdominal fluid collections. Intraperitoneal fluid may be either widespread or loculated. Enclosed fluid collections form a capsule or pseudo-capsule and are confined [4].

Ultrasound-guided evacuation is a process used to remove fluid collections such as abscesses, cysts, and other fluid accumulations. The radiologist utilizes ultrasound pictures to direct the evacuation catheter to the fluid collecting site. Once an evacuation catheter has been inserted into the fluid collecting site and fixed, a drainage bag is connected to it. Evacuation catheter is often kept in place for two to five days before being withdrawn [4].

There are three primary reasons for draining intra-abdominal fluid accumulation: infection management, identification of fluid, and symptom alleviation. Interventional radiologists are often requested to evacuate fluid accumulation in sepsis to achieve source control. On occasion, a fluid accumulation is observed unintentionally during imaging, and sample may be necessary to ascertain its origins. This is a typical occurrence in the postoperative period; the fluid accumulation may be a hematoma, urinoma, lymphocele, or abscess. Less often, a fluid accumulation may cause a patient discomfort. Symptomatic hepatic cysts,

lymphoceles, and pancreatic pseudocysts are examples.

Generally, relative limitations for evacuation of intra-abdominal fluid accumulation exist. Comparative limitations involve uncorrectable coagulopathy, hemodynamic instability, and lack of a safe catheter insertion window [5].

This research purposed to clarify role of ultrasound guided evacuation and intra-abdominal fluid collections aspiration.

2. Patients and methods

That cohort prospective research was conducted on 50 intra-abdominal fluid collections individuals who had ultrasound-guided percutaneous evacuation from those patients admitted to Benha University Hospitals till the end of the study.

The accumulation were discovered and located using ultrasonography or guided percutaneous needle aspiration, and a safe evacuation path that protected key anatomical structures was devised.

Inclusion criteria were patients who were diagnosed to have intraabdominal fluid collections with accessible ultrasound window. Patients were candidates for ultrasound guided drainage. Abnormal fluid accumulation and one of the subsequent: 1) Concern that fluid is contaminated, 2) Concern that accumulation is creating significant symptoms to require draining, 3) Unresponsive to medical therapy, 4) Prior to decisive surgery, a temporary procedure to stabilize condition of the patient.

Criteria of exclusion were patients with intra-abdominal collections with inaccessible ultrasound window, Patients with multiple abdominal collections, Patients who aren't candidates for ultrasound guided intra-abdominal fluid collection drainage and uncorrectable coagulopathy and Absence of a secure percutaneous access route to accumulation.

Patient were subjected to history taking to fulfill needed data: **Careful history taking** including (Age, gender, weight, height, BMI). With emphasis on the onset, course and duration of the presenting complaint and past history of previous operations. Comorbidities as DM, hypertension, CKD and COPD. **Clinical examination including** general examination: Vital signs involving systolic and diastolic BP, RR, body temperature and pulse. **Local examination:** Full examination of abdomen. **Laboratory investigations:** CBC as (Hb, platelets, WBCs), and clotting tests. liver function tests (ALT, AST). Kidney Function Tests (Creatinine, Urea).

Radio diagnostic imaging: Ultrasound is done before the procedure to assess the amount of intra-abdominal fluid collection and determine its accessibility.

Machine requirements: For abdominal ultrasonography and accompanying operations, a broad range of portable ultrasound equipment with 2D scanning capacity are utilized. In most cases, a 3.5 to 5.0 MHz transducer with a convex sector shape is optimal for abdominal scanning. If more detailed pictures are required, a linear transducer between 7.5 and 10 MHz may be employed.

In cases presented with intra-abdominal fluid collection, the ultrasound examination commented on: Location (intraperitoneal and retroperitoneal), **Nature of fluid collections (**unilocular and multilocular), **Volume of fluid collection:** detected by ultrasound before aspiration or drainage, **Relation to adjacent structures:** as omental fat, bowel loops, urinary bladder and other intra-abdominal organs, **Relation to major blood vessels** as portal vein and inferior vena cava.

Individuals were taken off antiplatelet or oral anticoagulants 5–7 days before surgery. Before and after the surgery, antibiotics were administered to all patients. All operations were conducted using local anesthetic with 2% Lidocaine and aseptic circumstances by the same gastroenterologist. In certain instances, intravenous conscious sedation and analgesia were utilized. For differential diagnosis, we utilized a two-step process known as the Seldinger method in B-mode paired with Doppler, and in select instances, contrast enhanced ultrasonography.

Catheter insertion technique: There are two procedures, and both involve inserting a needle into cavity.

1. The trocar technique: The Trocar procedure included puncturing the fluid accumulation directly with a trocar needle and inserting a catheter. After the catheter location has been optimized under imaging guidance, the trocar is withdrawn.

2. The Seldinger Technique: The Seldinger Procedure was executed by first puncturing accumulation with needles of tiny diameter (20 G to 22 G). A guidewire is introduced into fluid accumulation via needle. Needle is then withdrawn, while the guide wire remains in place. By exchanging dilators/guide wires, the needle tract is serially dilated. Lastly, an appropriately sized drainage catheter is introduced into the fluid accumulation over guide wire.

The operation was performed using local anesthetic and aseptic approach. When the guiding needle is in the proper place, a tiny incision is created along the needle and blunt dissection is done. The catheter installed on the trocar is then moved to a predetermined depth in exact parallelism with guiding needle. Even though form of accumulation is altered by respiratory or other movements, the exterior section of the guiding needle showed the correct entrance route and angle into cavity.

Appropriate location within the collection is determined by repeated US or by flowing fluid. catheter is linked to a drainage bag and fixed to the skin with sutures; a closed evacuation system was utilised to confine and avoid contamination of drainage. Utilizing a multi-hole peritoneal dialysis catheter, the catheter was periodically washed with a varied volume of saline to avoid blockage. The catheter is typically withdrawn when evacuated fluid becomes scarce and the patient's clinical state rebounds. Scanning must be repeated to track improvement.

Statistical analysis

SPSS v26 was used to do statistical analysis (IBM Inc., Armonk, NY, USA). Using the Shapiro-Wilks test and histograms, the normality of data distribution was determined. As mean and standard deviation (SD), quantitative parametric data were given. Non-parametric quantitative data were given as the median and interquartile range (IQR). The qualitative characteristics were provided in terms of frequency and percentage (%)

3. Results

Regarding demographic data of the studied patients, age ranged from 26-70 years with a mean of 47.5±13.14 years. There were 31(62%) males and 19 (38%) females. Weight of the studied patients ranged from 49-77 Kg with a mean of 64.26±5.91 Kg. Height ranged from 1.5-1.68 m with a mean of 1.58±0.05 m. BMI ranged from 20.44-29.9 Kg/m^2 with a mean of 25.83±2.69 Kg/m^2. Among the studied patients, there were 17 (34%) patients had CKD, 15 (30%) patients had hypertension, 11 (22%) patients had diabetes mellitus and 5 (10%) patients had COPD. Table (1)

Table (1): Demographic data and comorbidities of the studied patients.

	N=50
Age (years)	47.5±13.14 26-70
Sex	31(62%) 19 (38%)
Weight (Kg)	64.26±5.91 49-77
Height (m)	1.58±0.05 1.5-1.68
BMI (Kg/m^2)	25.83±2.69 20.44-29.9
CKD	17 (34%)
Hypertension	15 (30%)
Diabetes mellitus	11 (22%)
COPD	5 (10%)

Data were presented as mean ± SD, range and number (frequency), BMI: body mass index, CKD: chronic kidney disease, COPD: Chronic obstructive pulmonary disease.

Regarding the vital signs of the studied patients, HR ranged from 70-109 beats/min with a mean of 90.36±11.18 beats/min. RR ranged from 18-25 breath/min with a mean of 21.54±2.48 breath/min. SBP ranged from 110-150 mmHg with a mean of 132±13.09 mmHg. DBP ranged from 60-90 mmHg with a mean of 75.8±10.9 mmHg. Temperature ranged from 36.5-37.5 °C with a mean of 36.96±0.31°C. On the laboratory investigations of the studied patients, Hb ranged from 9-11 g/dL with a mean of 10.01±0.57 g/dL. WBCs ranged from 11-15 $*10^3$/ µl with a mean of 13.13±1.22 $*10^3$/ µl. Platelets ranged from 150-297 $*10^3$/ µl with a mean of 220.42±42.38 $*10^3$/

µl. Creatinine ranged from 0.7-2.5 mg/dL with a mean of 1.23±0.59 mg/dL. Urea ranged from 7-54 mg/dL with a mean of 26.46±13.17 mg/dL. ALT ranged from 21-147 U/L with a mean of 60.32±45.17 U/L. AST ranged from 20-150 U/L with a mean of 58.9±44.34 U/L. Table (2)

Table (2) Vital signs and Laboratory investigations of the studied patients**.**

	N=50
HR (beats/min)	90.36±11.18 70-109
Table (1) Continue	
RR (breath/min)	21.54±2.48 18-25
SBP (mmHg)	132±13.09 110-150
DBP (mmHg)	75.8±10.9 60-90
Temperature (°C)	36.96±0.31 36.5-37.5
Hb (g/dL)	10.01±0.57 9-11
WBCs (*10^3/ µl)	13.13±1.22 11-15
Platelets (*10^3/ µl)	220.42±42.38 150-297
Creatinine (mg/dL)	1.23±0.59 0.7-2.5
Urea (mg/dL)	26.46±13.17 7-54
ALT (U/L)	60.32±45.17 21-147 34 (27-107.5)
AST (U/L)	58.9±44.34 20-150 34 (27.5-106.25)

SBP: systolic blood pressure, DBP: diastolic blood pressure, HR: heart rate, RR: respiratory rate, Hb: Hemoglobin, WBCs: white blood cells, ALT: alanine transaminase, AST: aspartate aminotransferase. IQR: interquartile range.

Regarding the location of collection, it was intraperitoneal in 33(66%) patients and retroperitoneal in 17(34%). The nature of collection was liver abscess in 25(50%) patients, peripancreatic collection in 10 (20%) patients, GB perforation in 8 (16%) patients and appendicular abscess in 7 (14%) patients. Table (3)

Table (3) Location and nature of collection in the studied patients.

		N=50
Location	Intraperitoneal	33(66%)
	Retroperitoneal	17(34%)
Nature	Liver abscess	25(50%)
	Peripancreatic collection	10 (20%)
	GB perforation	8 (16%)
	Appendicular abscess	7 (14%)

GB: gall bladder

Nature of fluid was unilocular in 26 (52%) patients and multilocular in 24 (48%) patients. The volume drainage ranged from 476-775 ml with a mean of 622.74±84.39 ml. Catheter was the treatment option in 29 (58%) patients and Puncture was the treatment option in 21(42%) patients. The hospital stay was with a median of 2.5 days. Table (4)

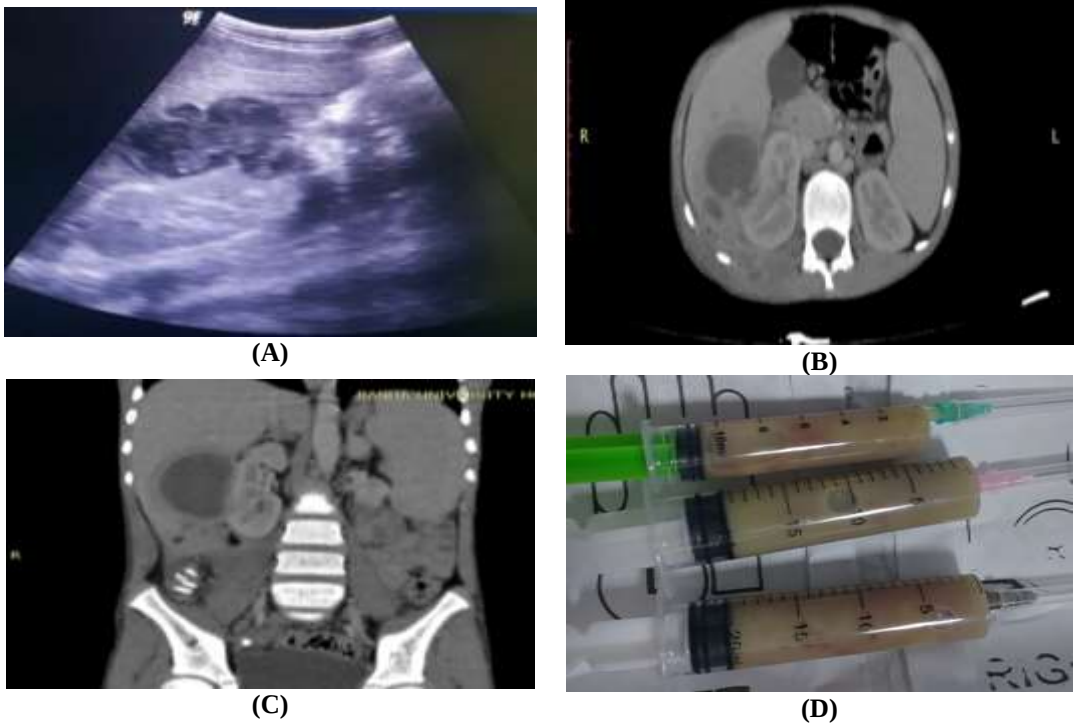
Table (4) : Nature of fluid, volume drainage and treatment option in the studied patients.

		N=50
Nature of fluid	Unilocular	26 (52%)
	Multilocular	24 (48%)
Volume drainage	Mean ± SD	622.74±84.39
	Range	476-775
Treatment option	Catheter	29 (58%)
	Puncture	21(42%)
Hospital stay (days)	Median (IQR)	2.5 (1.25-3)

Data were presented as mean ± SD, range and number (frequency), median [IQR (Interquartile range)].

Cases:

Case 1: Male patient 40 years old complains of right hypochondrial pain with fever. Abdominal ultrasound revealed right lobe of liver shows rather well defined multiloculated hypoechoic cystic lesion exhibiting turbidity measuring about (6x5x7.5cm), surrounded by hypoechoic lines of edema. First aspiration of the fluid then pig tail drain application **Fig. (1)**. Pathology revealed pus cells with inflammatory cells & necrotic debris.



(A) **(B)** **(C)** **(D)**

Fig. (1): (A-C) Abdominal ultrasound revealed right lobe of liver with well-defined multiloculated hypoechoic cystic lesion measuring about (6x5x7.5cm), surrounded by hypoechoic lines of edema, (D) aspiration of the fluid

Case 2: Female patient 30 years old with History of cholecystectomy 2 months ago with gradually growing right hypochondrial swelling and vomiting after meals. By ultrasound revealed well defined hypoechoic cystic lesion at the operative bed, clear aspect of the fluid, measuring about (12x14 cm) (Figure 2). Pathology revealed bile.

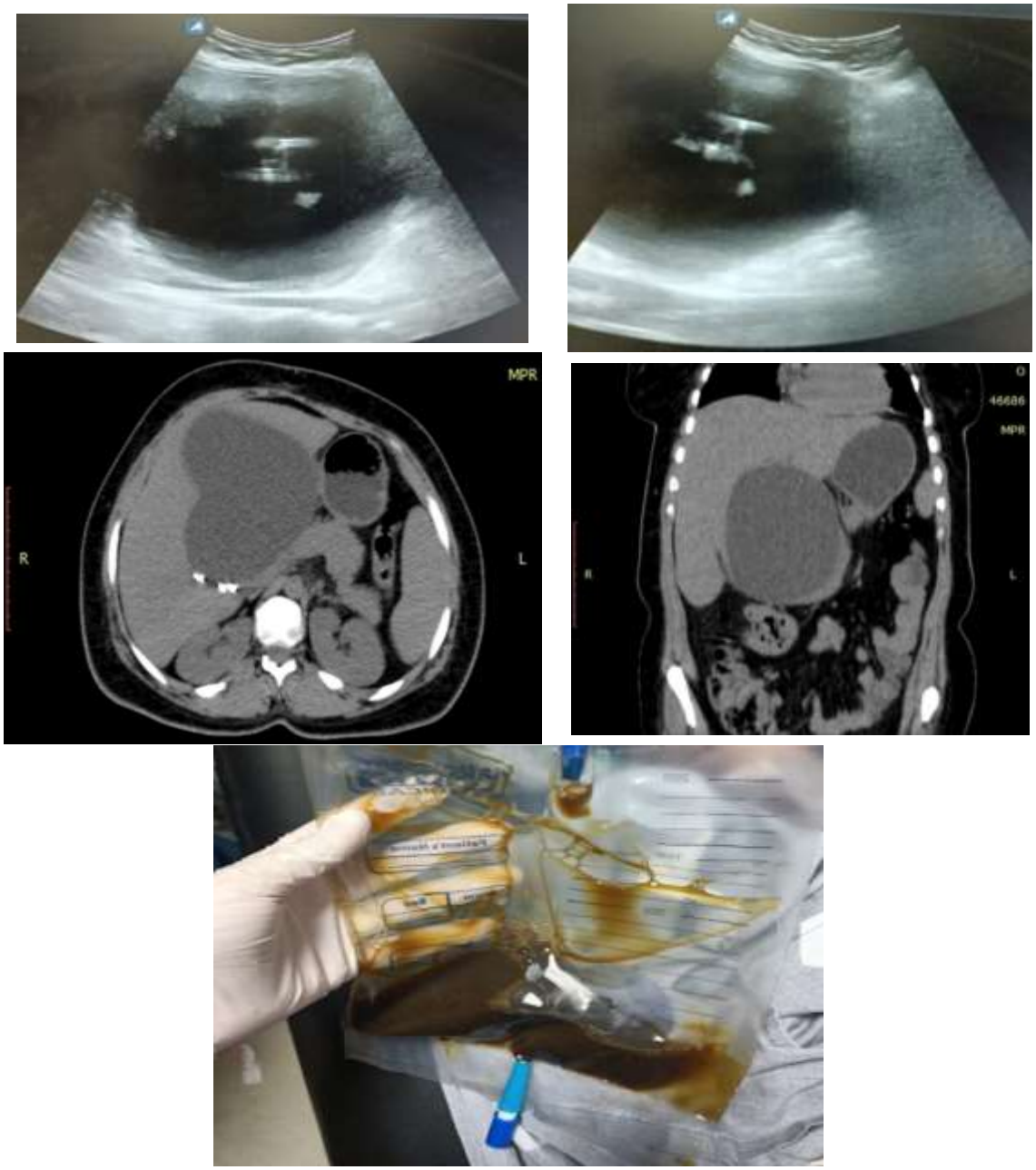


Fig. (2): A case with cholecystectomy, ultrasound revealed well defined hypoechoic cystic lesion, clear aspect of the fluid, measuring about (12x14 cm)

Case 3: Male patient 35 years old complains of right lower psoas muscle abscess. By ultrasound revealed right psoas muscle is seen bulky with noted rather ill-defined hypoechoic fluid collection, exhibiting turbidity, measuring about (5x4x8 cm) along its maximum dimensions, surrounded by diffuse inflammatory changes in the form of echogenic fat planes interlacing with hypoechoic planes of edema. Then subjected to Pig tail drain **Fig. (3)**. Pathology revealed pus cells with necrotic debris.

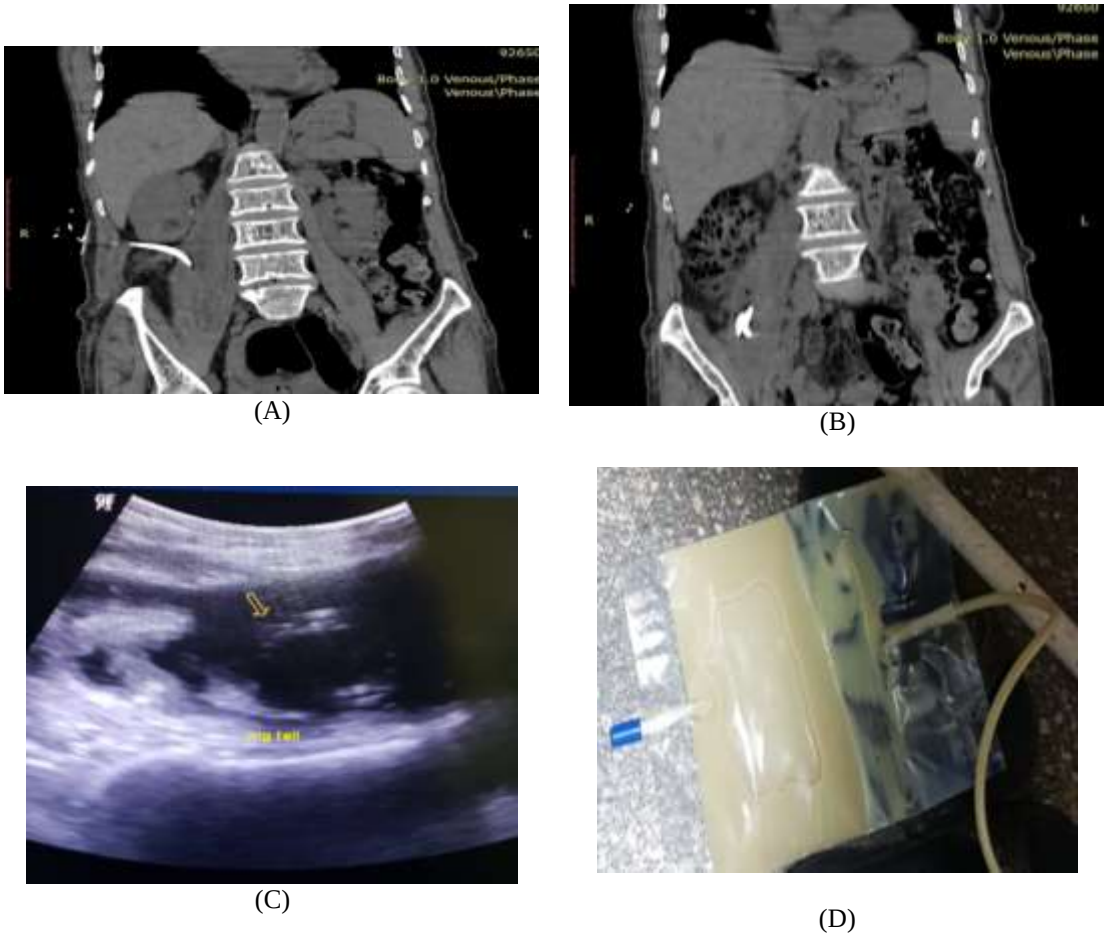


Fig. (3): A case with iliopsoas abscess, (A-C) ultrasound revealing right psoas muscle is seen bulky with ill-defined hypoechoic fluid collection, measuring about (5x4x8 cm) surrounded by echogenic fat planes interlacing with hypoechoic planes of edema, (D) Aspirated turbid fluid.

4. Discussion

Image-guided Percutaneous Evacuation of abdominal accumulation and abscesses has become therapeutic option regardless of origin in patients majority [6]. The operation is technically straightforward, repeatable, and economical, with the added benefit of being conducted under local anesthetic. Seriously sick patients who are unsuited for general anesthesia are hence candidates for PCD. PCD has supplanted the customary approach of abdominal collection evacuation in the majority of individuals and has been utilized as a temporary solution in extremely sick individuals [7].

Regarding demographic data of the studied patients in the current study, in agreement with our results, Stan-Ilie et al. (2021) [8] assessed effectiveness and safety of PD of visceral and non-visceral abdominal accumulation during a five-year period based on our personal experience. 66 individuals who received PD under ultrasound guidance were involved in the research. Along with the operation results, they assessed clinical characteristics (collection size, catheter diameter, collection type, microbiological analysis, and antibiotic regimens). The studied patients were 37 (56.1%) men and 29 (43.9%) females with a mean ± SD age of 64.03 ± 13.87 years.

Regarding the location of collection, it was intraperitoneal in 33(66%) patients and retroperitoneal in 17(34%). The nature of collection was liver abscess in 25(50%) patients, peripancreatic collection in 10 (20%) patients, GB perforation in 8 (16%) patients and appendicular abscess in 7 (14%) patients. In consistent with our findings, Stan-Ilie et al. (2021) [8] found that patients vast majority presented with visceral accumulations (one splenic hematoma and 38 hepatic abscesses), The remainder had non-visceral accumulations (27 individuals), inflammatory diseases, including diverticulitis and pancreatitis, or surgical procedures (subphrenic abscess, bilioma and perisplenic seroma).

In harmony with our findings, Wani et al. (2020) [9] conducted a prospective trial to investigate demographic and clinical characteristics of individuals suffering from intra-abdominal collections/abscesses, as well as viability of image-guided percutaneous evacuation as a temporary or permanent therapy. They included 90 individuals with intra-abdominal accumulation or abscesses who presented to a surgical unit at a hospital of tertiary care in a poor country. PCD was provided as the first mode of therapy. The majority of patients were found to have liver abscesses (64 percent), followed by post-operative accumulations (17 percent), Pancreatic pseudocyst/collections (8 percent) Gall bladder perforation with localized accumulations (3 percent) and Appendicular abscess (3 percent) and others (5 percent).

In the present study, the nature of fluid was unilocular in 26 (52%) patients and multilocular in 24 (48%) patients. The volume drainage ranged from 476-775 ml with a mean of 622.74±84.39 ml. Consistently, Wani et al. (2020) [9] reported that The average amount of fluid evacuated was 685 ml for liver abscess, 450 ml for post-operative accumulations, 1,015 ml for pancreatic pseudocyst/collection, 167 ml for gall bladder perforation, and 165 ml for appendicular abscesses. In addition, Majid et al. (2012) [10] reported that twenty three (53.5 %) of the collections were unilocular and 20 (46.5%) were multilocular.

However, Liu et al. (2022) [6] evaluated correlation among percutaneous catheter drainage timing and clinical development. This was a seven-year retrospective analysis of individuals with PLA who had received PCD. Early PCD was conducted when the amount of abscess decompression was less than 30 percent and/or within one week following fever start. Patients were categorised and studied according to the onset of PCD (early vs. delayed). Surprisingly, the majority of abscesses in our group were multiloculated (82.7 percent). Klebsiella pneumoniae was the most prevalent pathogen identified from pus (60.5 percent), followed by Escherichia coli (8.6 percent).

Regarding our study findings, catheter was the treatment option in 29 (58%) patients and puncture was the treatment option in 21(42%) patients. In line with our findings, Akhan et al. (2020) [11] The success and failure rates, as well as minor and severe consequences, of percutaneous draining of retroperitoneal abscesses were assessed. Among 1990 and 2010, 150 individuals with 170 percutaneously evacuated retroperitoneal abscesses were involved. Under the direction of ultrasound and fluoroscopy or CT, retroperitoneal abscesses were drained percutaneously. Six abscesses were evacuated using a single needle aspiration, while catheters were used to flush 164 abscesses. They reported that among 170 abscesses, 164 (96.5%) were treated using the catheterization technique, whereas 6 (3.5%) were treated by needle aspiration only.

In a study conducted by Grønvall et al. [12], Fifty intraabdominal abscesses were managed by sonographically guided evacuation in conjunction with complete cavity cleaning and local antibiotic application. 28 were managed with one or more punctures, and 22 were evacuated using a 1 2-14-gauge catheter, according to the paper.

Depending on availability, operator experience, body habitus, presence of nearby structures, size and location of the collection, and presence of intracavitary or intestinal gas, percutaneous drainage is curative in 80–100% of instances. The stated success rates for PCD vary between 80% and 100% . The decision among surgical and interventional radiologic evacuation has been the subject of much discussion. Mortality following radiologic evacuation varies between 1.4% and 15%. Recent research on 686 post-operative abscesses revealed, Politano et al. (2011) [13] contrasted surgical drainage (14.6%) to percutaneous radiologic evacuation (4.2%) for contaminated post-operative accumulations, and found a statistically critical change in mortality, particularly in the group of patients judged to be physically impaired (hemodialysis, diabetes and immunosuppression).

5. Conclusion

Image-guided percutaneous drainage of intra-abdominal abscesses and fluid collections is straightforward, cost-effective, and less traumatic, with fewer complications. It prevents the dangers of general anesthesia and is, therefore, the sole option for severely sick patients. PCD in conjunction with appropriate antibiotic treatment heals the vast majority of liver abscesses. PCD has become the preferred approach for discharging such accumulation. PCD is also helping to stabilize patients with symptomatic large pancreatic pseudocysts and acute fluid accumulation caused by acute pancreatitis who are in severe condition.

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