OUTCOMES AND COMPLICATIONS OF ULTRASOUND GUIDED PERCUTANEOUS DRAINAGE OF INTRA-ABDOMINAL ABSCESSES AT MOI TEACHING AND REFERRAL HOSPITAL.

MICHELLE NYAWIRA CLAY

A RESEARCH THESIS SUBMITTED TO THE SCHOOL OF MEDICINE IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN RADIOLOGY AND IMAGING OF MOI UNIVERSITY, SCHOOL OF MEDICINE

DECLARATION

Declaration by the Candidate

I declare that this thesis is my original work and has not been presented for a degree or any academic credit in any other University or examining body. No part of this thesis may be reproduced without the prior written permission of the author and/or Moi University.

MICHELLE NYAWIRA CLAY

Registration Number: SM/ PGR/01/2018

Department of Radiology and Imaging, Moi University

Signature:_________________________________ Date :________________________

Declaration by Supervisors:

This thesis has been submitted for consideration with our approval as University supervisors.

Dr. Loice Sitienei

Lecturer Moi University and Consultant Radiologist,

Department of Radiology and Imaging.

Moi University School of Medicine, Eldoret, Kenya.

Signature:_________________________________ Date :________________________

Dr. Cornelius Kipchirchir

Consultant Radiologist,

Department of Radiology and Imaging.

Moi Teaching and Referral Hospital, Eldoret, Kenya.

Signature:_________________________________ Date :________________________

DEDICATION

I dedicate this work to God, my mother Lucy Gitonga, my siblings, aunt Ann Gitonga and my friend Maureen who have been very supportive of me throughout this thesis.

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LIST OF ABBREVIATIONS

^{111}In	Indium 111
APACHE II	Acute Physiology, Age, Chronic Health Evaluation II
CIAOW	Complicated intra-abdominal infections worldwide observational study
CT	Computed Tomography
Ga 67	Gallium citrate Ga 67
HIV	Human Immunodeficiency Virus
IAA	Intra-abdominal Abscess
INR	International Normalized Ratio
IR	Interventional Radiology
MRI/MR	Magnetic Resonance Imaging
Msec	Milliseconds
MTRH	Moi Teaching and Referral Hospital
PCD	Percutaneous Catheter Drainage
PT	Prothrombin Time
RADPASS	RADiological Patient Safety System
SE	Spin echo
SSIs	Surgical Site Infections
TA	Acquisition Time
TE	Time to echo
TR	Repetition time
USG	Ultrasound guided
WBC	White Blood Cells

DEFINITION OF TERMS

Intra-abdominal abscess - An intra-abdominal abscess (IAA) is an intra-abdominal collection of pus or infected material usually due to a localized infection inside the peritoneal cavity.(*Intra-Abdominal Abscess - Symptoms, Diagnosis and Treatment | BMJ Best Practice US*, n.d.)

Percutaneous catheter drainage - Percutaneous abscess drainage uses imaging guidance to place a needle or catheter through the skin into the abscess to remove or drain the infected fluid.

Causative mechanisms – The means as to which the IAA occurred.

Outcome – The end result of a treatment or an intervention and in our case our outcomes will be either clinical outcomes or radiological outcomes.

Complication – A morbid process or event occurring during or after an intervention for a disease and may result from the intervention or from the disease for which the intervention is being done.

Surgical Site Infection – This refers to an infection that occurs after surgery in the part of the body where the surgery took place. (*Surgical Site Infection (SSI) | HAI | CDC*, n.d.)

ABSTRACT

Background: Intra-abdominal abscesses are a major contributor to morbidity and mortality around the world. More so in developing countries like Kenya where diagnosis and management are usually carried out late due to factors that include gender, level of education and long waiting time for specialized treatment. In the past and even currently, most of the Intra-abdominal abscesses (IAA) are treated via open surgery. However, with the age of Interventional Radiology, IAA are managed faster, and with better clinical and radiological outcomes. It is for these reasons that the role of Interventional Radiology needs to be assessed to see how better we can assist these patients.

Objective: To determine the causative mechanisms of intra-abdominal abscesses, assess clinical and radiological outcomes of patients with IAA after percutaneous drainage and assess any complications that may arise from percutaneous drainage of IAA.

Methods: This was a census, a prospective study conducted among 39 patients scheduled for percutaneous catheter drainage from January 2020 to December 2020. The study population was all patients who had confirmed intra-abdominal abscess in the outpatient department and in the medical and surgical wards, referred to the Interventional Radiology Department. A data collection form was used to record the demographics, causative mechanisms, radiological findings, microbiological features, clinical features and complication findings. The IAA were drained by the consultant radiologist under ultrasound guidance using a 3.5-5MHZ curvilinear transducer of Mindray M7. Data was extracted from the patients' records and there after presented in form of tables, diagrams and prose.

Results: The median age of patients was 40 (IQR 25, 48) years. The proportion of males was slightly higher (56.4%) compared to females (43.6%). Most (38.5%) of the IAA were complications following surgery; followed by trauma (25.6%) and cancer (23.1%). Majority (30.8%) of these IAA were in the right lower quadrant, sub-phrenic constituted 17.9% and psoas represented 12.8% of the sites. Out of the 39 patients included in the study, 28(71.8%) reported to have procedural complications. Of these 28, 26(92.9%) had minor complications that requires no therapy(Level A), 1(3.6%) had complications that resulted in hospitalization (Level C and D) while another 1(3.6%) had major complications that resulted in permanent change of the percutaneous catheter(Level E). Majority (88.5%) of those who had minor complication complained of pain, 1(3.8%) had a leak requiring no intervention while another 1 (3.8%) had fever post procedural.

Conclusions: The most common causative mechanism of IAA was as complications following surgery. Clinically most of the patients complained of abdominal pains. Radiologically, majority of the IAA contained purely fluid material, had minimal inflammatory changes and showed free fluid surrounding them. Only 1 of the patients had a major complication.

Recommendations: Clinical assessment of patients early; especially post-surgical patients to enable early detection of the IAA. Adequate post procedural analgesia with counselling on the expected complications.

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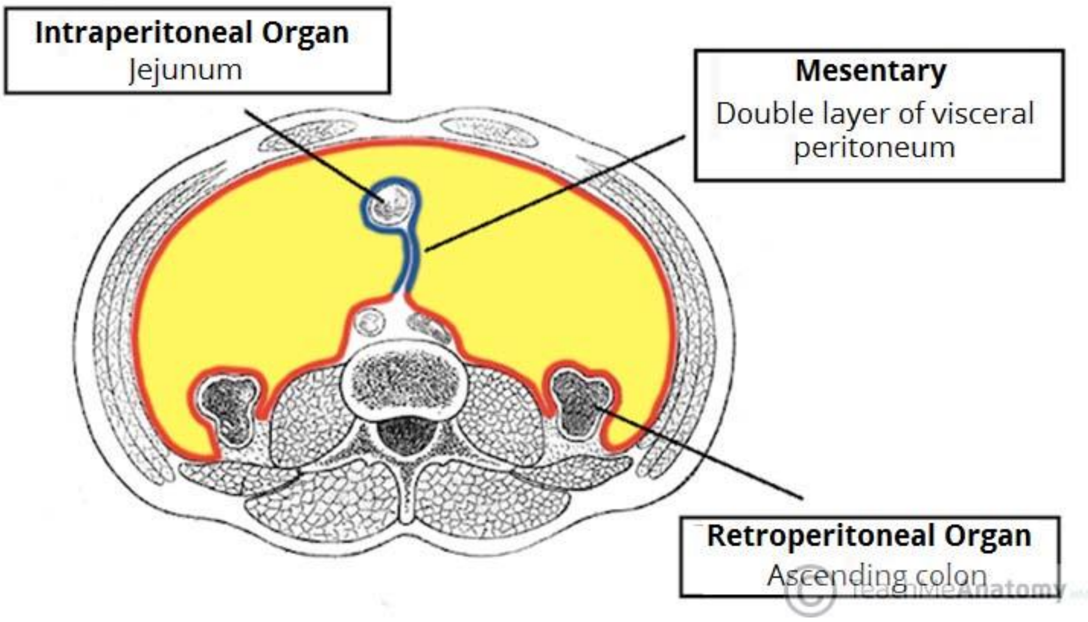
CHAPTER ONE

1.0INTRODUCTION

1.1 Background

Intra-abdominal abscess (IAA) is an intra-abdominal collection of pus or infected material usually due to a localized infection inside the peritoneal cavity. It is usually surrounded by inflamed tissue. It can involve any intra-abdominal organ or can be located freely within the abdominal or pelvic cavities. The eight functional compartments in the peritoneal cavity where an IAA abscess may develop include: the pelvis, right paracolic gutter, left paracolic gutter, right infra diaphragmatic space, left infra diaphragmatic space, lesser sac, hepatorenal space (Morrison space) and the interloop spaces between small intestine loops. (Saber, Alan A, 2018). In relation to intra-abdominal collections, intra-abdominal spaces are separate compartments within the peritoneal cavity, compartmentalized by various peritoneal ligaments and their attachments.

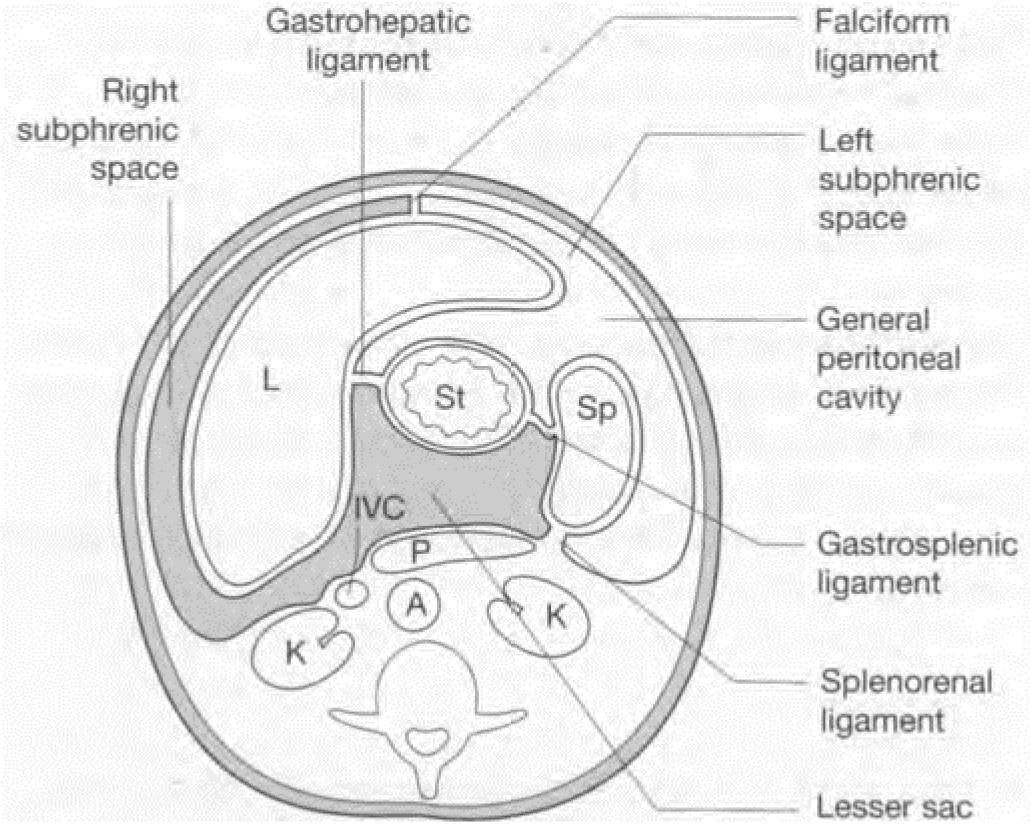


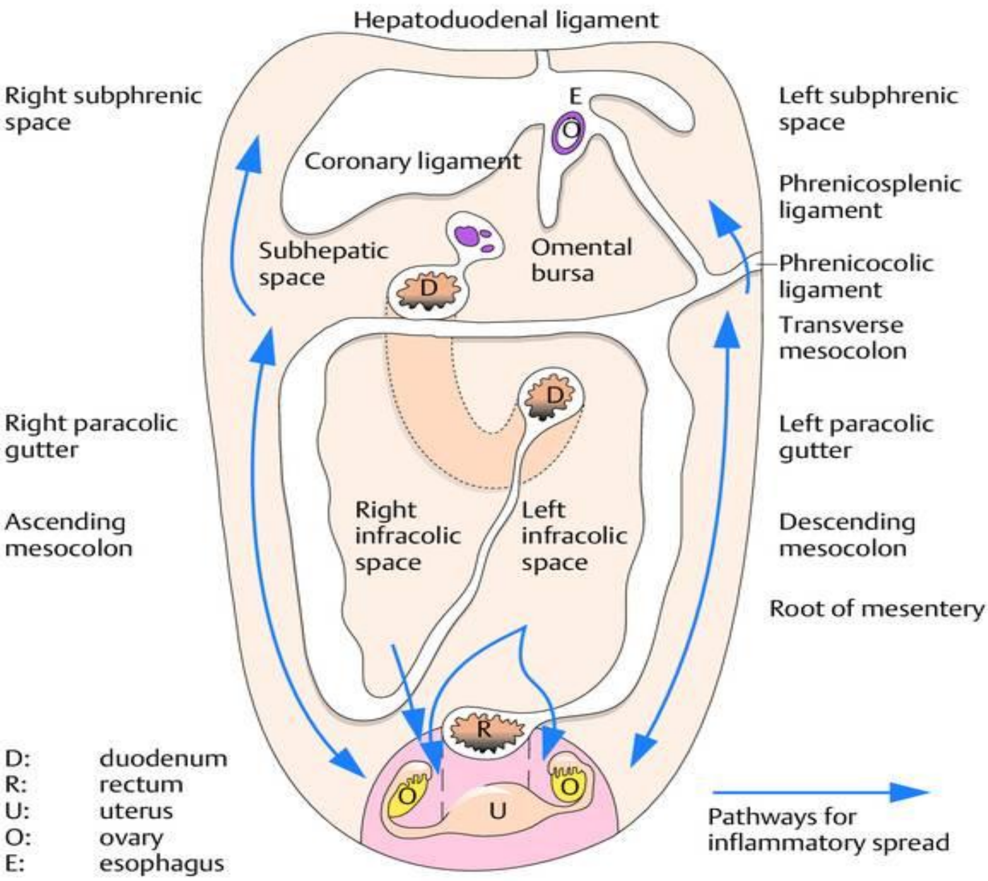
(*The Peritoneum - Visceral - Parietal - TeachMeAnatomy*, n.d.)

Figure 1: The Peritoneum - Visceral – Parietal

The peritoneal cavity can be divided into the following spaces:

- Supramesocolic space:
    - Right supramesocolic space
        - Right subphrenic space
        - Anterior right subhepatic space
        - Posterior right subhepatic space (Morison pouch)
        - Lesser sac
    - Left supramesocolic space
        - Left subhepatic space
            - Anterior left subhepatic space
            - Posterior left subhepatic space
        - Left subphrenic space
            - Anterior left subphrenic space
            - Posterior left subphrenic (peri splenic) space
- Inframesocolic space
    - Right inframesocolic space
    - Left inframesocolic space
    - Right and left paracolic gutters
- Pelvic spaces
    - Para vesical spaces
    - Rectovesical pouch
    - Rectouterine space (Pouch of Douglas): in females (Dr Craig Hacking and Dr Prashant Mudgal et al, n.d.)





(Nuernberg, n.d.)

IAA is almost always secondary to a pre-existing or other disease process. Although multiple causes of intra-abdominal abscesses exist, the most common causes are: Perforation of viscus, which includes peptic ulcer perforation, perforated appendicitis and diverticulitis, gangrenous cholecystitis, mesenteric ischemia with bowel infarction, pancreatitis or pancreatic necrosis progressing to pancreatic abscess. Other causes include untreated penetrating trauma to the abdominal viscera and postoperative complications, such as anastomotic leakage or missed gallstones during laparoscopic cholecystectomy. (Saber, Alan A, 2018)

It is estimated that about 70% of IAA are postsurgical and that 6% of patients undergoing colorectal surgery may develop a postoperative abscess. Hepatic abscesses account for 13% of all intra-abdominal abscesses. (Nisarg Y. Mehta; Eddie L. Copelin II, n.d.) IAAs are a form of Surgical Site Infections. The World Health Organization released a report showing that in the United States of America, in 2010, 3654 hospitals reported 20916 SSI among 2417933 surgical procedures performed in that year. In Australia, a total of 183625 procedures were monitored and of those, 5123 Surgical Site Infections were reported. In Japan, the cumulative incidence of SSI for colon and rectal surgery was reported as 15.0% (6691/44751 procedures) and 17.8% (3230/18 187 procedures), respectively. In the Republic of Korea, the overall SSI rate represented 2.10% of the total of 18 644 operations and differed after various types of surgery.

In Singapore, the overall SSI rate represented 2.10% of the total of 18644 operations and differed after various types of surgery. In Uruguay, the national incidence data on SSI for 2012-2013 reported that the incidence rate for appendectomy was 3.2%, 2.5% for cardiac surgery, 6.2% for cholecystectomy and 15.4% for colon surgery. Chile showed an SSI rate of 3.09% for coronary bypass surgery and 1.89% for hip joint replacement. In low- and medium-income countries, the pooled SSI incidence was 11.8 per 100 surgical patients undergoing surgical procedures (95% CI: 8.6–16.0) and 5.6 per 100 surgical procedures (95% CI: 2.9–10.5). High rates of SSI following caesarean section were reported in several low- and medium-income countries: 16.2% in a study from Nigeria (44), 19% from Kenya, 10.9% from Tanzania and 9.7% by Viet Nam. In 2 studies from Brazil, one reported a rate of 9.6% and the other a higher rate of 23.5%. In comparison, a much lower average SSI rate of 2.9% is reported in Europe. (*Global Guidelines for the Prevention of Surgical Site Infection*, 2016)

Intra-abdominal abscesses are classified as intraperitoneal, retroperitoneal, or visceral. Many intra-abdominal abscesses develop after perforation of a hollow viscus or colonic cancer. Others develop by extension of infection or inflammation resulting from conditions such as appendicitis, diverticulitis, Crohn disease, pancreatitis, pelvic inflammatory disease, or indeed any condition causing generalized peritonitis. Abdominal surgery, particularly that involving the digestive or biliary tract, is another significant risk factor: The peritoneum may be contaminated during or after surgery from such events as anastomotic leaks. Traumatic abdominal injuries may also develop abscesses, whether treated operatively or not.

Cross sectional imaging can be used as one of the modes of diagnosis of an IAA. Plain radiography findings of an extraluminal gas collection, while pathognomonic, are clearly seen prospectively in only a small percentage of cases. Barium contrast examinations, by either oral or rectal administration, are often necessary to confirm the extraintestinal location of inappropriate gas collections. (Ferrucci & vanSonnenberg, 1981)

Real-time fluoroscopy, on the other hand, is useful in guiding percutaneous drainage of abscesses in specific locations; for example, it can be used in conjunction with ultrasound to facilitate drainage of subphrenic abscesses while avoiding pleural transgression. Fluoroscopic guidance is also useful for aiding catheter manipulations, such as catheter repositioning and exchanges after initial placement of the percutaneous catheter. (*Abdominal Abscess | Radiology Key*, n.d.)

As adequate institutional capability for ultrasonography and body CT become increasingly available, these methods have become the preferred techniques for detection of intraabdominal abscesses. Both share the following characteristics for diagnosis of abdominal disorders: high accuracy, rapid speed of examination, and completely noninvasive character. Their cross-sectional tomographic nature allows both intra organ and extra organ and extra alimentary fluid collections to be displayed with remarkable precision, often in far more detail than is disclosed by even exploratory laparotomy. (Ferrucci & vanSonnenberg, 1981).

Ultrasonography is exquisitely sensitive to the presence of fluid within the abdominal cavity, while CT, a more powerful tool, can accurately identify fluid collections in sites inaccessible to ultrasound and can more definitively display other diagnostic features, including the presence of an abscess wall and intralesional gas or air fluid levels. Both permit immediate rapid imaging of numerous organs or anatomic compartments for a complete abdominal survey examination - a major advantage over organ-specific examinations such as excretory urography or radionuclide liver scan, and neither requires any special preprocedural preparation. Both techniques can also be used to guide percutaneous needle puncture procedures and catheter drainage for definitive therapy. (Ferrucci & vanSonnenberg, 1981)

On ultrasonography, the high accuracy of gray-scale ultrasonography for the detection of abscesses and the differential diagnosis of intra-abdominal fluid collections has been established by several groups. The ultrasound image is acquired when an electric current is applied to a synthetic piezoelectric crystal. When the current is applied, the crystal will vibrate and emit very high frequency sound waves. With current clinical instrumentation, the transducer (crystal) emits sound waves approximately 1% of the time; during the remainder of the time it acts as a receiver. The sound waves are emitted in straight lines from the surface of the transducer; some are reflected at tissue interfaces while others are not. The reflected waves are received by the transducer and are in turn converted into electrical signals that are displayed on an oscilloscope or strip chart recorder. (Friday et al., 1975)

The velocity of sound in tissues is essentially constant; therefore, the time necessary for a beam of sound waves to travel from the transducer to a reflecting surface and back provides a measure of the distance of that structure from the transducer. From a display of such echoes, the distance from the skin to a reflecting surface, or from one reflecting surface to another, can be measured. The vertical displacement of the pulses displayed on the oscilloscope is related to the intensity of the sound beam that has been reflected. A display limited to a series of such pulses is called "A mode." With "A mode," a structure can be located and its diameter along the path of the sound beam determined. In "B mode" display, each echo appears on the oscilloscope as a dot. (Friday et al., 1975)

As the transducer is moved in across the area being examined, all the resultant echoes are displayed as dots, creating an image that represents a cross section of the plane traversed by the beam of sound waves. In this mode, organ outlines are generated. Regardless of mode, further information can be obtained by altering the sensitivity of the receiver electronics. For example, fluid-filled structures are sonically homogeneous, readily transmit sound waves, and, at high sensitivities, do not have internal echoes. On the other hand, solid structures absorb sound waves readily and have internal echoes at high sensitivities. Therefore, the nature of a structure, i.e., whether cystic or solid, can be determined by altering the sensitivity level of the transducer electronics. It is necessary that the ultrasonic transducer be closely applied to the skin. This is done by applying mineral oil or gel to the skin at the site of examination. (Friday et al., 1975)

The presence of drains and dressings may interfere with adequate skin contact. If one angles the transducer or examines the patient from the side or in the prone or supine position, one may obtain a satisfactory examination. On occasion, air or barium in the bowel may interfere with the transmission of sound. Usually these difficulties can be overcome by examining the patient following the introduction of a decompression tube or the use of enemas to evacuate the bowel. In most instances, the application of some ingenuity and perseverance will produce a technically adequate scan. Occasionally serial examinations are necessary. A full urinary bladder is very helpful in the evaluation of the abdomen.

The gain level at which internal echoes appear in the bladder can be used as a comparison with other structures. If the echoes appear at a lower sensitivity level than the bladder, this would suggest the presence of internal structures such as septi, calcium, debris, and so on. In addition, the bladder is a very helpful anatomic landmark. This is of advantage when one is examining the pelvis. If there is any question of mistaking the presence of a sonolucent mass for that of the urinary bladder, a second scan following urination will clarify the findings. Thus, ultrasound not only provides a technique for detection of an intraabdominal mass and its relationship to other structures, but can help ascertain if the mass is cystic, solid, or of mixed consistency. (Friday et al., 1975)

Typically, the sonographic appearance of a fluid collection is one of few internal echoes, and sharp, strongly reflective, well-defined margins. Usually there is enhanced brightness of structures deep to the fluid collection compared with similar structures that are overlaid by solid tissue (through transmission). In the largest reported series of abdominal abscesses examined by ultrasonography, Taylor et al correctly diagnosed and located 70 of 75 abdominal and pelvic abscesses (sensitivity, 93.3%). These investigators were also able to exclude abscess correctly in 143 of 145 patients (specifically, 98.6%). Doust and associates and Doust and Thompson have outlined some of the specific sonographic characteristics of abscesses and suggested criteria for differentiation between abscess, hematoma, seroma, and lymphocele. Abscesses are typically rounded, oval, or ellipsoidal, indicating encapsulated fluid under pressure; collections of loculated ascitic fluid, on the other hand, may have a discrete margin, but typically display sharp, angular marginal indentations due to the shaping effect of bordering organ contours. Generally, abscesses display slightly irregular walls and contain weakly echogenic debris, which may be dispersed throughout the abscess cavity or may be dependently layered. (Ferrucci & vanSonnenberg, 1981)

Intrahepatic and perihepatic abscesses may cause diagnostic problems. Thus, differentiation of pyogenic and amebic liver abscesses is usually not possible. It is also frequently difficult to be certain whether a superficially located liver abscess is in fact within the hepatic substance or in the perihepatic or subphrenic space. Subhepatic abscesses may require differentiation from a distended gallbladder, while fluid-filled bowel loops always should be considered in the differential diagnosis of an intra-abdominal fluid collection. Usually fine, movable, dispersed echogenic material can be identified within a dilated fluid-filled bowel, representing intestinal contents being churned by peristalsis. This feature is best displayed by real-time sonographic scanning.

Additional limitations or pitfalls of ultrasonography arise from the problems inherent in sonographic technology and instrumentation. Thus, intestinal gas reflects the sound beam and may prevent examination of portions of the abdominal cavity, such as the left upper quadrant where the stomach and left side of the colon may be interposed between the transducer and deeper fluid collections. Similarly, in obese patients scattering of the sound beam often gives unsatisfactory scans; open wounds, colostomies, and dressings also limit sonographic survey. The volume of a fluid collection can be easily estimated by ultrasonography, especially if the collection is approximately ellipsoidal. A satisfactory estimate of volume (mL) is 0.5 (length x breadth x depth [cm]). This calculation is useful in predicting the volume of an abscess before percutaneous needle aspiration and serves as an effective means of assessing the success of drainage, either by needle aspiration, catheter, or open surgical approach. (Ferrucci & vanSonnenberg, 1981)

The advent of real-time ultrasonography adds an important new dimension to the investigation of suspected abdominal abscesses. Currently available real-time systems produce hundreds of sonographic images per minute, allowing a great number of scanning planes to be quickly recorded so that areas previously inaccessible because of ribs, bandages, or gas pockets can now be satisfactorily examined. Complete sonofluoroscopic survey of the abdomen for the presence of intra-abdominal abscess can now be accomplished in as short a period as five minutes, including hard-copy images for permanent documentation. Increasingly, real-time sonofluoroscopy is replacing conventional B-scan gray-scale equipment and is especially beneficial for rapid investigation of the conditions of critically ill patients. (Ferrucci & vanSonnenberg, 1981)

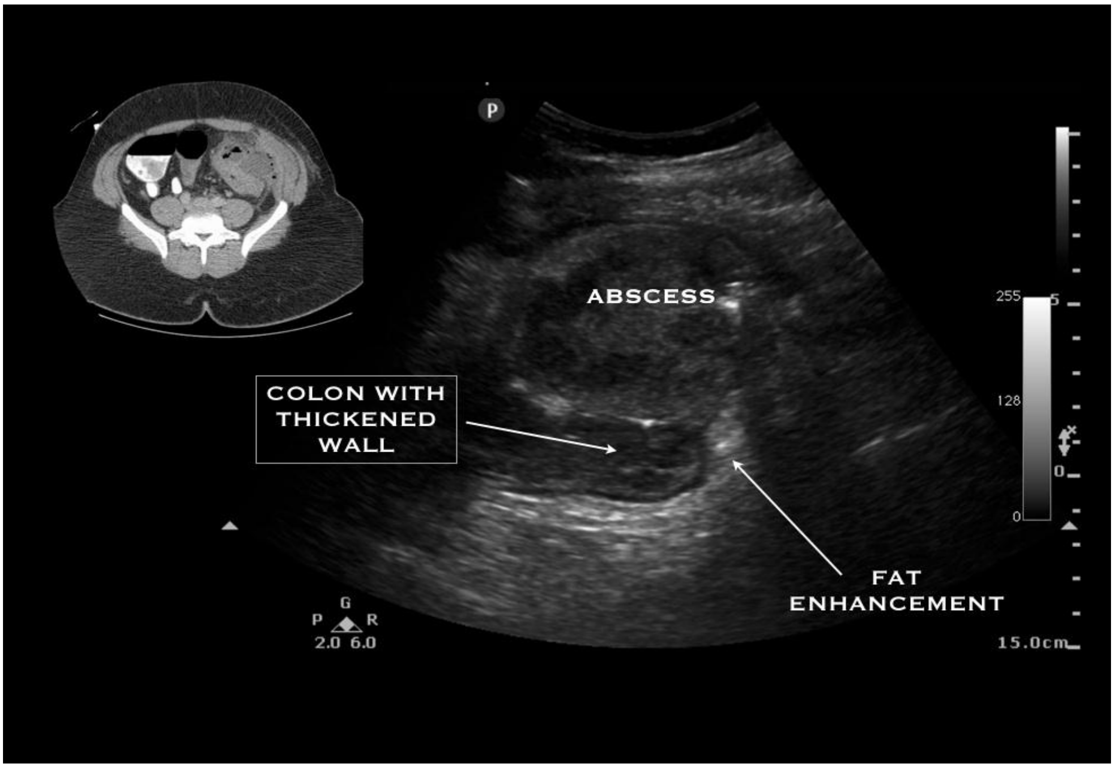


Figure 2: A bedside ultrasound used to diagnose an intraabdominal abscess in a patient with perforated diverticulitis.

The image shows a bedside ultrasound used to diagnose an intraabdominal abscess in a patient with perforated diverticulitis. The patient was a 43-year-old male on antibiotics following a recent diagnosis of diverticulitis who presented with increasing left lower quadrant pain. To perform the exam, they placed the curvilinear probe on the patient's abdomen over the point of maximal tenderness. It shows a section of sigmoid colon with a thickened wall, surrounding fat stranding, and a large overlying intraabdominal abscess. (*Ultrasound for Diverticulitis? | Emory School of Medicine*, n.d.)

Another method of diagnosing IAAs is Contrast-enhanced ultrasound (CEUS). Contrast-enhanced ultrasound (CEUS) is a new technique that involves intravenous administration of an ultrasound contrast agent in a real-time examination, providing an accurate depiction of the bowel wall microvasculature and the peri enteric tissues. The preliminary experience with first-generation US Doppler-enhancing air-filled contrasts (Levovist®), confirmed it as a sensitive method to differentiate between a phlegmon and an abscess. (Ripollés et al., 2013)

Tomás Ripollés et. al performed a retrospective study between June 2006 and May 2012 where the contrast-enhanced ultrasound (CEUS) was performed. Patients were examined with a 3–4 MHz convex probe in the wideband contrast harmonic mode (pulse inversion Toshiba Aplio) at low MI (MI < 0.10). The second-generation echo-signal enhancer SonoVue® (Bracco, Milan, Italy) was injected as a bolus in units of 1.2 mL through a three-way 20-gauge catheter into an antecubital vein, immediately followed by injection of 10 mL of normal saline solution (0.9% NaCl). For each examination, a recording was begun a few seconds before the intravenous administration of the contrast agent, and continuous imaging was performed for 40 seconds. Digital video sequences were recorded in audio video interleaving (AVI) format. On US examination a phlegmon was considered as an ill-defined hypoechoic mass without identifiable wall and internal color signals on color Doppler. On the other hand, abscesses were diagnosed as hypoechoic fluid collections with an irregular wall and peripheral flow on color Doppler. (Ripollés et al., 2013)

Once the suspected areas were identified on baseline US and color Doppler, they were evaluated after second-generation contrast agent injection. In contrast-enhanced study a diagnosis of phlegmon was made when intralesional enhancement was seen, while abscesses showed absence of enhancement in the hypoechoic mass. The initial report made on site was used for the diagnosis of phlegmon or abscess. There was not one single case where the images were reviewed to change the diagnosis. However, because the results of US depend strongly on the observer's ability and subjectivity, two experienced abdominal radiologists with five years' experience in CEUS retrospectively reviewed the video sequences at the time of the present study to calculate the interobserver agreement. These findings were only used to calculate the interobserver agreement, but they did not change the diagnosis based on the initial report. CEUS morphologic findings in abscesses are quite typical. Fluid filled loops of bowel are also seen as non-enhancing areas, like abscesses, but they can be easily distinguished by their peristalsis, long shaped morphology and the absence of enhancing echogenic tissue. Reactive loculated peritoneal fluid may also mimic an abscess, but a simple fluid collection can be compressed with the transducer and moreover, it will not demonstrate an enhancing wall. (Ripollés et al., 2013)

Computed tomography can also be used in detection of an IAA. The detection of intra-abdominal abscesses by CT has been even more accurate than by ultrasound. Major interpretive criteria include identification of a circumscribed area of uniform low CT attenuation values or a frank fluid collection in an extra alimentary location or within the parenchyma of a solid abdominal organ, such as the liver. The low-density attenuation values of an abscess usually fall between those of water (0 to 10 Hounsfield units) and solid-tumor tissue (50 to 60 Hounsfield units). Abscess collections as seen by CT are most often rounded or oval, but can be crescentic or semilunar in shape, especially when confined within the perihepatic or perinephric spaces. Intralesional gas is an important supporting feature and is seen in some 30% to 50% of intra-abdominal abscesses. The gas may be dispersed diffusely throughout the abscess as fine low attenuation bubbles or may coalesce into one or more larger fluid levels.

Extra organ abscesses may disclose a more- or less-clearly defined outer wall or rind of hyper vascular reparative tissue, which may be enhanced in visibility following the administration of intravenous iodinated contrast materials. A normal abdominopelvic CT scan in a patient with a suspected abscess can be taken as reliable clinical data. False positive errors have resulted from confusion of abscess with bowel loops and from inability to differentiate abscess from diffuse phlegmonous inflammatory reaction. Intrahepatic abscesses are usually well-delineated rounded or oval areas of low attenuation on plain CT scans obtained without iodinated intravenous contrast material. Psoas abscess may produce diffuse swelling of the psoas muscle belly, as well as central low-density areas, and gas bubbles. (Ferrucci & vanSonnenberg, 1981)

A study by Rails and co-workers correctly identified an abscess via CT in 78 of 79 proved cases, while only one of 32 patients with a normal CT scan had an abscess requiring drainage. The reported accuracy of abscess detection by CT has been consistently superb, with true-abnormal (sensitivity) rates of 90% to 95% and true normal (specificity) rates for exclusion of abscesses of the same order of magnitude. (Ferrucci & vanSonnenberg, 1981)

It is useful to reemphasize that unlike sonography, falsely normal CT scans are extremely uncommon and have usually been due to very small abscesses, nonlocalized inflammation, such as phlegmon or vasculitis, or misinterpretation of a demonstrated lesion.

Radionuclide scintigraphy is another radiological method of detecting an abscess. Gallium citrate Ga 67, originally used as a tumor-scanning agent, has also been highly successful in the diagnosis and localization of intraabdominal abscesses. Abnormal scans disclose discrete focal areas of increased radionuclide uptake and have been found to be 80% to 90% sensitive for abdominal abscess detection in several reports. A major advantage of gallium citrate Ga 67 scanning is that a whole-body image can be obtained, occasionally displaying clinically occult septic foci such as a myocardial abscess, vertebral osteomyelitis, or synthetic graft infection. However, several disadvantages mitigate its wide applicability. The specificity of an abnormal gallium citrate Ga 67 scan is quite low (high false positive rate), in that uptake occurs in abscesses as well as tumors, areas of postoperative and phlegmonous reaction, and wounds. Further, a considerable amount of the injected material is excreted through the gut, usually about 10%, but on occasion much more. Therefore, considerable caution must be exercised in the evaluation of abdominal collections of gallium citrate Ga 67. Practical considerations therefore require that actual scanning be done 48 to 72 hours after the injection of the radionuclide material to allow adequate gut cleansing, often a prohibitive delay. (Ferrucci & vanSonnenberg, 1981)

More recently, improved results have been obtained with autologous leukocytes labeled with indium 111, which has also proved to be an effective preparation for identifying inflammatory processes. Since labeled white blood cells are not excreted by the kidneys or gut, abnormal accumulations of ^{111}In in the abdomen cannot be a result of normal fecal concentration. Similarly, recent surgical wounds show considerably less uptake of ^{111}In than gallium citrate Ga 67. However, ^{111}In is a cyclotron produced isotope, and its preparation does require care to preserve function of leukocytes. Initial favorable results were reported by McDougall et al, who found abnormal scans in 11 of 12 patients with proved abscess, whereas in 21 patients with a normal scan, 18 had no evidence of an abscess. In a subsequent, larger study, Knöchel et al found a 92% overall accuracy with a sensitivity of 86% and a specificity of 95% in a series of 170 cases. (Ferrucci & vanSonnenberg, 1981)

Magnetic Resonance Imaging (MRI) is another radiological method for abscess detection. In the past few years, there has been an increasing trend in the use of MRI for diagnosis of intra-abdominal abscesses. MRI offers several advantages over CT, the chief ones being the absence of ionizing radiation and the superior soft tissue resolution. MRI is particularly preferred in pediatric patients and young adults because of the concerns about the harmful effects of ionizing radiation. This is particularly true in patients with Crohn's disease, who often undergo multiple cross-sectional imaging studies in their lifetime, and intra-abdominal abscesses frequently complicate their clinical course. MRI has a problem-solving role in the characterization of complex adnexal lesions in women of reproductive age and aids in the diagnosis of tubo-ovarian abscesses. The routine use of MRI for detection of abscess is however limited by the lack of MRI expertise, high cost, and long scanning times in abdominal MRI examinations. It is also difficult to perform good-quality examinations on critically ill patients. On MRI, intra-abdominal abscesses typically demonstrate inhomogeneous areas of hypo intensity on T1-weighted images and intermediate intensity to hyperintensity on T2-weighted images. After intravenous administration of gadolinium, the abscess demonstrates intense wall enhancement as on CT. (*Abdominal Abscess | Radiology Key*, n.d.)

In a study done by Susan D. Wall et, al MRI data collected for each abscess included site, size, homogeneity, presence of a capsule or gas, intensity changes within the abscess with different repetition rates, and the effect on surrounding tissues. T1 and T2 relaxation times were calculated and compared to normal values for fat, muscle, liver, and urine. The MR images were analyzed independently by three observers for the above factors. To measure T1 relaxation times, two scanning sequences were necessary. They used a short (500 or 1000 msec) and a long (1500 or 2000 msec) TA. To measure the T2 relaxation time, only one scanning sequence was required, preferably the longest TR (2000 msec), but two TEs are necessary. The region of interest for calculation of these factors was specifically selected to include greater than 20 pixels, because less reliable values for T1 and T2 times were obtained when a smaller region of interest was used. In addition, at least three region-of-interest measurements were obtained for improved accuracy of the measured T1 and T2 values. T1 measurements were computer-generated by integrating the signal intensity images of a selected region of interest on images obtained at two different TRs (500 and 1500 or 500 and 2000 msec). T2 measurements were computer-generated by integrating the first and second SE images having the longer TR (2000 msec). The MR and CT scans were analyzed separately for the previously mentioned data factors, and subsequently the findings were compared. (Wall et al., 1985)

Results showed MRI appearance with variations in TR/TE. The abscess appearance on MRI was dependent on TR and TE imaging factors. Percentage of contrast determinations showed that the abscesses adjacent to fat showed the greatest contrast with adjacent structures on the SE 500/28 (TR/TE) images. Those abscesses adjacent to muscle were best seen and showed greatest contrast on images obtained with 1500 msec or 2000 msec TR and 56 msec TE. In general, the abscesses appeared as abnormal areas of low signal intensity on the short-TR (500 msec) images and had a relatively higher signal intensity on the longer-TR (2000 or 1500 msec). The abscesses in the study had longer mean T1 and mean T2 (1107 and 81 msec, respectively) values compared to fat (mean T1 = 243 msec, mean T2 = 55 msec), muscle (mean T1 = 528 msec, mean T2 = 29 msec), and normal liver (mean T1 = 377 msec, mean T2 = 45 msec), but shorter than those of urine (mean T1 = 2964 msec, mean T2 = 166 msec). In five patients, the abscess collection was heterogeneous in signal intensity and in five patients, it was homogeneous (low signal intensity) on the shorter TR. The heterogeneous pattern of signal intensity was more apparent in each case on images using longer TR (1500 or 2000 msec) and TE (56 msec). A capsule surrounding the abscess was identified in four patients and was of low signal intensity on both long and short TRs, but often it was better visualized on the longer-TR and longer-TE images. (Wall et al., 1985)

Gas was an absence of signal on both long and short TRs in the abscesses of two patients. In four patients, the abscess was adjacent to the aorta, inferior vena cava, or other large vessels. In each case, displacement or compression of these vessels was identified on MRI because their recognition was facilitated by the intraluminal signal void from rapid laminar flow within them. Inflammatory involvement of surrounding muscles was detected on MRI by the finding of abnormally high signal intensity in focal areas of adjacent muscles. Intestinal involvement was demonstrated by thickening of adjacent bowel wall. Bone destruction, present in one case, was identified by disruption of the normally low signal intensity of cortical bone and by replacement of the normally high signal intensity of bone marrow with a heterogeneous pattern of high and low signal intensity. Multiplanar imaging was useful in precise localization of two abscesses. (Wall et al., 1985)

When they compared MR and CT findings, a comparative CT scan was available in six cases, in two of these cases, the abscesses were seen as areas of homogeneous soft-tissue density. The remaining four abscesses had a CT density lower than that of the surrounding soft tissues. Of the four patients found to have a capsule on MRI, three had a correlative CT scan. Of these three, none had an identifiable capsule on

CT, even after intravenous administration of contrast medium. Gas was identified on the CT scans in the same two patients in whom it was seen with MRI. In those patients whose abscess was adjacent to vasculature as seen on MRI, two had CT scans; in one case, the vessels were identified only after intravenous administration of contrast medium. Involvement of adjacent musculature, demonstrated in five cases with MRI, and bowel, shown in one case with MRI, was not well delineated on CT. However, bone destruction was better seen with CT in the one case where it occurred. MRI delineated an abnormal area of signal intensity and suggested that it was the abscess in question in each of the patients studied. CT identified an abnormal area that appeared to be an abscess in five of six patients. (Wall et al., 1985)

In the approach to abscess imaging, while institutional technical bias or expertise is an important factor in the conduct of the radiological search for intra-abdominal abscess, certain general clinical guidelines have evolved. The search for an abscess should be initially guided by localizing signs, symptoms, laboratory data or from the suspected site and nature of surgical complications. Knowledge of the anatomy of the intra-abdominal compartments and the pathways for spread of intraabdominal fluid to sites of high predilection for abscess location expedite the radiological search. It is to be emphasized that when there are localizing findings clinically, or the patient is critically ill, radiological workup begins with either ultrasonography or body CT. Even if a fluid collection is delineated by the initial study, in some instances the other modality may be required to define the process further. If both sonography and CT are normal, investigation for abscess can be discontinued, since persistent or pressing clinical abnormalities in such patients are soon likely to eventuate in another obvious explanation. When there are no localizing clinical findings, and no acute illness is present, a more leisurely evaluation, beginning with a radionuclide scan may be considered. An abnormal radionuclide scan result warrants follow-up with an ultrasonographic or CT examination tailored to explore the area of abnormality seen on the scan. Should the radionuclide scan result be normal, the presence of an inflammatory focus becomes extremely unlikely. (Ferrucci & vanSonnenberg, 1981)

Management of IAA involves image-guided percutaneous drainage or surgical drainage in combination with intravenous antibiotic administration. Invasive interventional radiological techniques for percutaneous diagnostic needle-aspiration of fluid collections under ultrasonographic or CT guidance have been widely employed and can be followed by percutaneous catheter drainage for definitive non-surgical therapy. (Ferrucci Jr & vanSonnenberg, 1981). Percutaneous drainage is an effective method for treatment of abdominal abscesses and is indicated when sectional imaging demonstrates an accessible unilocular lesion. (Gerzof et al., 1981). Advantages of ultrasound guided percutaneous drainage include that it is a dynamic study, allowing greater precision to control needle insertion. Other advantages include that it does not expose patients to ionizing radiation and does not require as wide a range of staff, compared to CT-guided procedures. Its disadvantages include; deeper targets may not be as well-visualized on ultrasound (e.g. retroperitoneal nodes) and bowel gas may obscure visualization and that there is poor attenuation of the sound beam on larger patients. (Kusel & Hameed, 2013)

Indications for US guided PCD are broad: essentially any abnormal fluid collection in the patient which can be accessible. Examples include complicated diverticular abscess, Crohn's disease related abscess, complicated appendicitis with appendicular abscess, tubo-ovarian abscess, post-surgical fluid collections, hepatic abscess (e.g. amoebic or post-operative), renal abscess or retroperitoneal abscess and splenic abscesses. Some of the contraindications include; biopsy target being inaccessible and if the patient has a bleeding diathesis. (Kusel & Hameed, 2013)

The prognosis of intra-abdominal abscesses is evident from published rates of mortality that range from 30% in treated patients to 80% to 100% in patients with undrained abscesses. (Ferrucci Jr & vanSonnenberg, 1981)

Image-guided percutaneous catheter drainage (PCD) has been shown to be effective therapy in carefully selected patients who have IAA. Hemming et al demonstrated that patients who underwent PCD of intra-abdominal abscesses had the same length of stay, morbidity rate, and mortality rate as matched patients stratified for site and severity who had open operative drainage. Percutaneous catheter drainage is also now a commonly used staging method for the resolution of intra-abdominal sepsis prior to corrective operation. Additionally, the role of the interventional radiologist in treating these patients is extremely gratifying, in that patients usually recover quickly as soon as the infected material has been drained. (John A. Kaufman, n.d.)

There are different types of catheters used in PCD. The various catheters available for drainage include sump designs and non-sump designs. Sump catheters have double lumens and are particularly suited for intraabdominal abscesses. The outer lumen in the sump catheter is designed to prevent side holes from becoming blocked when the catheter is adjacent to the wall of an abscess cavity. Twelve- to 14-French sump catheters are suitable for most intraabdominal abscesses. However, sump catheters are not necessary. Most pigtail catheters with reasonably large side holes work well in conjunction with adequate flushing. Larger (16- to 28-French) catheters are required in specific circumstances such as for pancreatic abscesses, hematomas, or when the abscess cavity contents are extremely viscous. Non-sump catheters are used in the chest. Generally, these catheters have large side holes to permit appropriate drainage. Catheters inserted in the chest also tend to be larger (16- to 30-French) because kinking occurs commonly with smaller catheters because of respiratory excursion, which compresses the catheter against adjacent ribs. There is a vogue to place smaller pigtail catheters in the chest, which the author does occasionally for simple fluid collections, but for empyema, the author prefers to place larger catheters. Locking pigtail catheters (8- to 10-French) are used in specific circumstances such as when draining lymphoceles and seromas, or when draining deep pelvic abscesses transrectally or transvaginally. It is important to use locking catheters when using the transvaginal or transrectal route because any abdominal straining may dislodge a nonlocking catheter. (John A. Kaufman, n.d.)

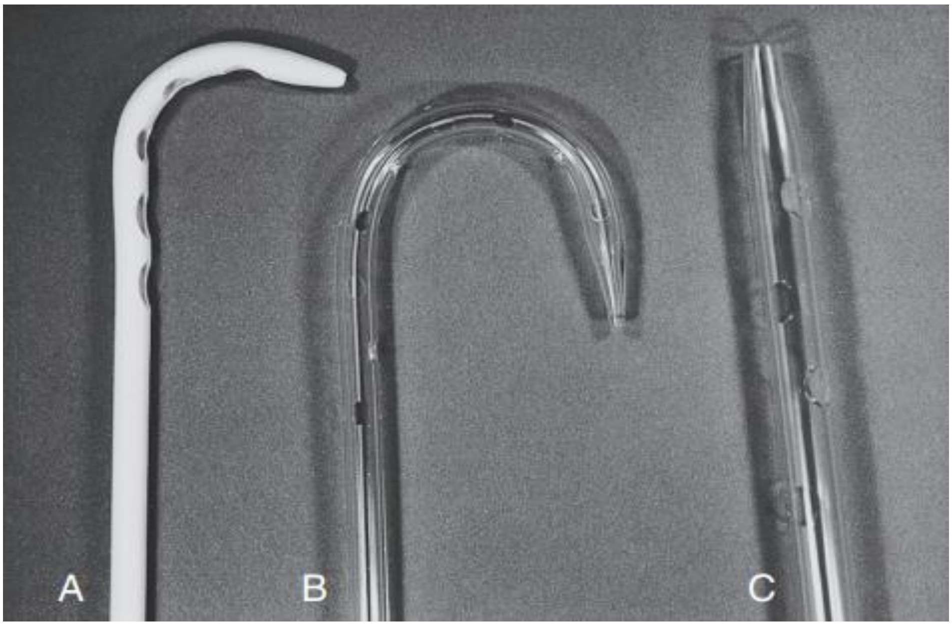


Figure 3: Various catheters used for abscess drainage. A, 14-French sump catheter (Boston Scientific, Natick, Mass.). B, 16-French nonsump catheter (Cook, Bloomington, Ill.). C, 24-French nonsump drainage catheter (Cook, Bloomington, Ill.).

Various catheters used for abscess drainage. A, 14-French sump catheter (Boston Scientific, Natick, Mass.). B, 16-French nonsump catheter (Cook, Bloomington, Ill.). C, 24-French nonsump drainage catheter (Cook, Bloomington, Ill.). The sump catheter comes in 12- or 14-French sizes and is the predominant catheter used by the author for abdominal abscess drainage. The 16- and 24-French catheters are used for empyema drainage and for abscesses in the abdomen that need larger catheters placed. (John A. Kaufman, n.d.)

Prior to fixation of the catheter, diagnostic fluid aspiration is done. Diagnostic fluid aspiration is often requested to determine whether a fluid collection detected by either CT or sonography is infected or uninfected. It is important to plan the access route carefully so that bowel is not transgressed en route to the collection. This is to ensure that a potentially sterile collection is not contaminated by a diagnostic aspiration. Generally, a 20-gauge needle is used for diagnostic aspiration. This can be performed under ultrasound or CT guidance, provided a safe access route is visible. Two to 3 mL of fluid is aspirated, and specimens sent for Gram stain and culture. If fluid cannot be obtained with a 20-gauge needle, an 18-gauge needle is placed in tandem to the 20-gauge needle into the fluid collection. Failure to aspirate fluid through this 18-guage needle usually means that the cavity contents are very viscous. Fluid can usually be aspirated in small amounts if rapid to-and-fro motions with the 18-gauge needle are performed. Alternatively, 1-2 mL of sterile saline can be injected into the cavity and reaspirated for the purpose of Gram stain and culture. If the sample obtained is pus, a catheter should be placed straight away. If the specimen obtained is not pus and it is unclear whether it is infected or not, either wait for the result of the Gram stain or place a catheter. Some interventional radiologists prefer to wait for the result of the Gram stain. It is the practice in the author’s unit to place a drain in most abdominal collections, particularly if the patient is sick and has a high temperature. One can then await the result of the Gram stain and culture. If these are negative, the catheter can be removed after 48 hours. It is important for the interventional radiologist to be able to interpret Gram stain results because the result may directly affect decision making. A Gram stain that has abundant bacteria and white cells indicates an abscess. A stain that yields bacteria without white cells may be consistent with colonic contents. The CT scan should be reviewed to confirm that the suspected abnormality does represent an abscess and not unopacified colon and that the aspiration needle did not traverse the colon. Alternatively, bacteria without white cells may mean that the patient is immunocompromised and cannot mount a leukocyte response. It is not uncommon, with the modern use of antibiotics, that a Gram stain may show white cells without bacteria, indicating a so-called sterile abscess. These collections should, however, be drained. (John A. Kaufman, n.d.)

1.2 Statement of the problem

Intra-abdominal abscesses are a major contributor to morbidity and mortality around the world. Mortality rate in cases of untreated IAA may be as high as 80% to 100%. (Ferrucci Jr & vanSonnenberg, 1981) Early diagnosis and management is therefore crucial in the survival of these patients. Percutaneous Catheter Drainage is a mode of management of IAAs where contents of infected collections are syphoned out under either ultrasonography, computed tomography or fluoroscopic guidance; using tubes and catheters. Successful cure rates of up to 86% have been documented. (*Grainger & Allison's Diagnostic Radiology 5th Ed 2008*, n.d.-a). There exists little information on the causes and complications of percutaneous drainage of IAA in Africa and therefore this study will be crucial in bridging this gap. In the past and even currently, most of the IAA are treated via open surgery. Utilization of PCD is low. We aim to shift our mode of management from open surgery to PCD especially for stable patients. Successful abscess resolution after percutaneous drainage has been shown to be as high as 79 percent even in older patients. (Malangoni et al., 1990a) with a different study showing success rates of as high as 90.8%. (vanSonnenberg et al., 1984a) with an average of about 70-93% success rate. (Schechter et al., 1994a) However, with improvement in our health systems and training, advancement in imaging and interventional radiology modalities, IAA can now be managed effectively with less invasive techniques.

1.3 Study justification

Percutaneous catheter drainage of IAA is a fast and efficient way of managing these patients. It is minimally invasive, turnaround time for intervention is faster, cost is reduced, and areas like the retroperitoneal space can be accessed. This study therefore aims to demonstrate these advantages in relation to the patients managed at Moi Teaching and Referral Hospital. It will also help in finding out both the clinical and radiological outcomes of patients with IAA and further enhance our knowledge on the radiological management of these patients in our interventional radiology department. The research study will also open avenues for further research.

1.4 Research questions

What are the most common causative mechanisms of intra-abdominal abscesses and what are the outcomes and complications of percutaneous catheter drainage for IAA at Moi Teaching and Referral hospital - Eldoret, Kenya?

1.5 Objectives

1.5.1 Broad objective

To determine the causative mechanisms of intra-abdominal abscesses; assess clinical and radiological outcomes of patients with IAA after percutaneous drainage and assess any complications that may arise from percutaneous drainage of IAA.

1.5.2 Specific objectives

1. To assess the causative mechanisms and locations of intra-abdominal abscesses.
2. To assess the clinical and radiological outcomes of percutaneous drainage of IAA.
3. To assess complications arising after percutaneous drainage of IAA.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Causative mechanisms and location of IAA in patients admitted to the hospital

Most abscesses are postoperative, because of acute inflammatory abdominal condition like cholecystitis, appendicitis, diverticulitis with or without perforation, due to associated inflammatory bowel disease, due to trauma, or due to tuberculosis. (Radiology, n.d.)

Intra-abdominal sepsis most frequently follows penetrating or blunt abdominal trauma or perforated appendicitis or diverticulitis. The initial leakage of the endogenous gastrointestinal microflora into the peritoneal cavity results in peritonitis and secondary septicemia, which is frequently followed by localized intra-abdominal abscess. These infections are most frequently polymicrobial and relate directly to the unique endogenous microflora at the various levels of the gastrointestinal tract. The treatment of intra-abdominal sepsis is primarily centered around prompt, appropriate surgical intervention. Parenterally administered antibiotics are also required to decrease the chance of local bacterial infection or septicemia. (Nichols, 1986)

Patient presenting symptoms are an important aspect in diagnosis and treatment of an IAA. The most common presenting symptoms for IAA have been shown to be pyrexia in 39 (97%), abdominal tenderness in 32 (80%), guarding in 1 (2.5%) and abdominal mass in 3 (7.5%). (Saber, Alan A, 2018). However, the clinical presentation can be quite variable.

Abscesses occurred most commonly in the subphrenic space, pelvis, or subhepatic space. (Fry et al., 1980). A study done on the improved localization and survival of patients with IAA showed that of 100 patients analyzed in regards to etiology, abscesses developed in 71% of these patients as a result of spontaneous intraabdominal disease, and in 29% as a complication of operation or procedures.(Saini et al., 1983). Intra-abdominal infections differ from other infections through the broad variety in causes and severity of the infection, the etiology of which is often polymicrobial, the microbiological results that are difficult to interpret. (Blot & De Waele, 2005). With the age of laparoscopic surgery, IAA have become more common with studies showing that there is a significant increase in the incidence of postoperative intra-abdominal abscess with perforated appendicitis after laparoscopic compared with open appendectomy in pediatric patients. (Krisher et al., 2001). Laparoscopic appendectomy for perforated appendicitis is associated with a higher rate of postoperative intra-abdominal abscess formation without the benefit of a shortened hospital stay. (Paik et al., 1997)

Intra-abdominal sepsis most frequently follows penetrating or blunt abdominal trauma or perforated appendicitis or diverticulitis. The initial leakage of the endogenous gastrointestinal microflora into the peritoneal cavity results in peritonitis and secondary septicemia, which is frequently followed by localized intra-abdominal abscess. These infections are most frequently polymicrobial and relate directly to the unique endogenous microflora at the various levels of the gastrointestinal tract. The treatment of intra-abdominal sepsis is primarily centered around prompt, appropriate surgical intervention. Parenterally administered antibiotics are also required to decrease the chance of local bacterial infection or septicemia. (Nichols, 1986)

Diagnosis is made majorly using ultrasound, but CT has also been used effectively in the diagnosis and management of IAA. Ultrasonic scanning was used to examine 102 patients suspected of having a postoperative intra-abdominal abscess. An intra-abdominal fluid collect ion was demonstrated in 16 patients; in all 16 the diagnosis was confirmed by operation or necropsy. (Maklad et al., 1974).

Percutaneous catheter drainage of intra-abdominal abscesses currently is a well-established technique. Adequate drainage documented by pelvic computerized tomography scans and follow-up confirmed satisfactory long-term results. (Dov et al., 1986). Percutaneous CT-guided abscess drainage is an effective method for treating intra-abdominal abscess and should be considered as the treatment of choice in patients with localized intra-abdominal abscess without signs of generalized peritonitis. (Khurrum Baig et al., 2002).

Subphrenic and other upper abdominal abscesses continue to be associated with high mortality, even in today's era of broad-spectrum antibiotics and sophisticated surgical techniques.

Conventional radiography also remains an effective method in the initial detection of upper abdominal abscesses. (Connell et al., 1980)

(Krisher et al., 2001)(Paik et al., 1997)In IAA after penetrating abdominal injury, over 80 percent of penetrating wounds leading to abscesses occurred in the upper quadrants, and common risk factors included multiple intra-abdominal solid organ injuries requiring open drainage, coupled with gastrointestinal tract perforation.

Table 1: Location of Abscess on Diagnostic Imaging Study

Location	No. (%)
Right lower quadrant/flank/gutter	24 (25)
Right subphrenic/subhepatic	22 (22)
Left lower quadrant/flank/gutter	21 (22)
Pelvis/perirectal	16 (17)
Lesser sac	16 (17)
Left subphrenic	4 (4)
Retroperitoneal (perinephric/psoas)	4 (4)
Biliary tree	3 (3)
Other intraperitoneal	5 (5)

(Cinat et al., 2002)

Table 2: Origin of Intra-abdominal Abscesses

Origin	No. (%)
Colon and rectum	27 (28)
Liver and biliary tree	20 (21)
Appendix	19 (20)
Pancreas	12 (13)
Small bowel	8 (8)
Stomach and duodenum	6 (6)
Renal	1 (1)
Unknown	3 (3)

(Cinat et al., 2002)

2.2 Clinical, microbiological and radiological outcomes of percutaneous drainage of intra-abdominal abscesses

Patient presenting symptoms are an important aspect in diagnosis and treatment of an IAA. The most common presenting symptoms for IAA have been shown to be pyrexia in 39 (97%), abdominal tenderness in 32 (80%), guarding in 1 (2.5%) and abdominal mass in 3 (7.5%). However, the clinical presentation can be quite variable. Studies have shown that percutaneous drainage of an intra-abdominal abscess is as efficacious as surgical drainage and that APACHE II scores are prognostic of both potential mortality and morbidity. (Hemming et al., 1991). Percutaneous catheter drainage of intra-abdominal infections was effective with a single treatment in 70% of patients and increased to 82% with a second attempt. A successful outcome is most likely with abscesses that are postoperative, not pancreatic, and not infected with yeast. Percutaneous catheter drainage is now a commonly used staging method for the resolution of intra-abdominal sepsis prior to corrective operation. (Cinat et al., 2002). Successful abscess resolution after percutaneous drainage has been shown to be as high as 79 percent even in older patients. (Malangoni et al., 1990b) with a different study showing success rates of as high as 90.8%. (vanSonnenberg et al., 1984b) with an average of about 70-93% success rate. (Schechter et al., 1994b). In a study done of 250 percutaneous abscesses, 209 cases, operation was avoided through percutaneous drainage and the patients were cured (83.6%). Partial success was achieved in 18 of 41 recurrences and failures; in these patients, operation was necessary, although the patient benefited from the percutaneous drainage. Cures and partial successes totaled 227/250 (90.8%). Noninfected collections were successfully drained in 31/43 cases. There were 21 failures (8.4%) and 20 recurrences (8%). These were most often due to fistulae, phlegmons, organized tissue, or underlying tumor. (vanSonnenberg et al., 1984a) A one-year retrospective review of percutaneous abscess drainage (PAD) of 323 patients, showed an overall cure rate of 62.4% (209 of 335 abscesses), with a failure rate of 8.95% (30 of 335 abscesses). With attention directed to body location, associated organ system, communications and fistulae, and to the underlying immunologic status of the patient. One-year follow-up was available in all patients. There were 14.2% (46 of 323 patients) deaths in the follow-up period, of which 4.6% (15 of 323 patients) were believed attributable to sepsis or septic complications. For the patient exhibiting immunocompromise, representing 53.1% (172 of 323 patients) of the patient population, the cure rate was 53.4% (95 of 178 abscesses), which was significantly lower than the cure rate of 72.6% (114 of 157 abscesses) for the immunocompetent patient population (n = 151) (P less than .001). The recurrence rate was 2.1% (seven of 335 abscesses), with all recurrences within 3 months of initial drainage. PAD is therefore an effective and permanent treatment for both immunocompromised and immunocompetent patients. (Lambiase et al., 1992). The principle of intra-abdominal infection management is to control the infectious source. In cases complicated by abscess formation, percutaneous drainage has emerged as the first-line therapy over surgical intervention due to lower complication rates and shorter length of hospital stay. The American Society of Colon and Rectal Surgery, Expert Panels of the Surgical Infection Society, the Infectious Diseases Society of America, and the World Society of Emergency Surgery currently recommend, where feasible, percutaneous abscess drainage over surgical drainage. This strategy is supported by strong published clinical evidence in support of percutaneous drainage as a first-line treatment to manage appendicitis, diverticulitis, and Crohn's disease. (Park & Charles, 2012). A study done in 2001, showed a total of 14,068 abdominal abscesses were drained percutaneously. This volume increased progressively every year thereafter, reaching 28,486 in 2013 (+102%). Open surgical drainage volume was 8,146 in 2001, decreasing progressively to 6,397 in 2013 (–21%). In 2001, 63% of all abdominal abscesses had been drained percutaneously; by 2013, this figure had risen to 82%. In 2001, radiologists had performed 90% of all percutaneous abdominal abscess drainages; this percentage share increased to 97% in 2013. Of all abdominal abscesses treated in 2013 in Medicare patients, 79% were treated by radiologists. Use of percutaneous drainage of abdominal abscesses has therefore steadily increased, whereas use of open surgical drainage has declined. Most of these abscesses are now treated percutaneously. Radiologists are a strong majority of those performing the procedures. Although this database does not provide information on clinical outcomes, percutaneous drainage is another good example of radiology-related value. (Levin et al., 2015). Percutaneous abscess drainage is one of the most common and rewarding procedures performed by interventional radiologists. Technical success is immediately apparent by aspiration of purulent contents and is nearly always achieved, with rates exceeding 90% in most literature studies. Clinical success is typical even for many abscesses colonized with multidrug-resistant organisms. In patients presenting with sepsis, this procedure offers an immediate and minimally invasive solution to a life-threatening condition, often resulting in defervescence and restoration of hemodynamic stability within 1 to 2 days. (Lorenz & Thomas, 2006a)

Table 3: Cumulative Success Rates for Multiple Attempts with Percutaneous Catheter Drainage

No. of Attempts	No. Successful	Cumulative Success Rate, %
1	67	70
2	12	82
3	1	83
4	1	84
5	0	84

(Cinat et al., 2002)

Although our study did not delve into the microbiological outcomes most of the studies added an additional assessment of the microbiological features of IAAs. One study showed that aspirate from the IAA of all patients showed bacterial abnormalities. A total of 290 bacterial isolates were identified and included Bacteroides species (17%), Escherichia coli (17%), Streptococcus species (14%), Enterococcus species (10%), and Klebsiella species (6%). Sixty-four patients (67%) had polymicrobial abscesses;

Yeast was isolated from abscesses in 11% of the patients. Postoperative abscesses yielded fewer organisms than those that were not postoperative and were more likely to contain Enterococcus species (37% vs 13%). Primary (non-postoperative abscesses) were more likely to contain Escherichia coli (57% vs 27%), Streptococcus species (46% vs 13%), and Bacteroides species (44% vs 24%).(Cinat et al., 2002). A common finding with the Gram stain is the presence of white blood cells but no bacteria, a so-called sterile abscess. This is typical in patients who have been hospitalized and have had extensive antibiotic administration. (vanSonnenberg Eric et al., 2001)

2.3 Complications of Percutaneous Catheter Drainage

Complications of PCD include complications of sedation, drug-related allergic reactions, cardiopulmonary complications, infectious complications, bleeding, and non-target access. The goal should be to maintain a complication rate at or below standards reported in the literature. (Lorenz & Thomas, 2006b). The rate of complications has been shown to be approximately 10.4% with only about 2.8% experiencing major complications. (vanSonnenberg et al., 1984a). Twenty-six patients experienced complications (10.4%), seven of which were major (2.8%) (vanSonnenberg et al., 1984a).

Fluid collections within the liver parenchyma can be drained with an ~4% risk of major complications and a 1 to 2% risk of minor complications. Major complications have included hepatocolic fistula creation, sepsis due to communication of the abscess cavity with hepatic vascular structures, and death by biliary peritonitis. The most common minor complication is treatment failure resulting in repeat drainage or surgery and occurring in 16 to 18.5% of cases. Abdominal fluid collections resulting from perforated viscus due to such entities as Crohn's disease, previous operation, diverticulitis, and appendicitis can be drained with a less than 5% incidence of complications, as evidenced by large published series. The general complications of non-target embolization, bleeding, and infection may occur infrequently, with an incidence of less than 3%. Pancreatic collections resulting from pancreatitis or pancreatic duct injury are associated with a high incidence of treatment failure when drained by external radiological drainage. Reported complications of nonselective radiological and endoscopic management include hemorrhage, sepsis, persistent enteric or cutaneous fistula, tract infection, and a higher rate of mortality compared with open surgical management. Percutaneous drainage of renal and perinephric fluid collections results in treatment failure requiring surgery, including nephrectomy, in over 30% of cases. Iliopsoas abscesses can be safely drained with a low risk of periprocedural complications but a risk of treatment failure exceeding 30% in some studies. (Lorenz & Thomas, 2006a)

Table 4: Adverse Events following Percutaneous Catheter Drainage

Adverse Event	No. of Patients
Drain-related	19
Falling out	8
Manipulation or reposition required	7
Damaged	2
Obstructed	2
Rehospitalization	7
Fistula formation	4
Bleeding	4
Cellulitis	3
Inability to place drain	2
Total	**39**

(Cinat et al., 2002)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Site

The study was conducted at the Moi Teaching and Referral hospital, radiology and imaging department, in the interventional radiology room.

The Moi Teaching and Referral Hospital is in Eldoret town, the headquarters of Uasin Gishu county. It is the second largest referral hospital in Kenya after Kenyatta National Hospital It is 350km North West of the Kenyan capital Nairobi. The hospital serves an estimated population of 16.24 million which is 42.5% of Kenya's population as per the 2010 Kenya population Census survey. It has a bed capacity of 800 with several departments including surgery, pediatrics, medicine, obstetrics and gynecology, radiology and imaging, accident and emergency department among others.

It is also the teaching hospital for Moi University College of Health Sciences that trains both Undergraduate Medical Students and several master's in medicine specialist programs with over 240 post graduate students (Registrars) distributed across several programs. (mtrh, n.d.)

3.2 Study design

This was a census, a prospective study and was carried out for a period of one year.

3.3 Study Population

The study ran for a period of 12 months and included all patients with intra-abdominal abscesses in surgery, medical and interventional radiology department.

3.3 Eligibility Criteria

3.3.1 Inclusion Criteria

All patients with Intra-Abdominal Abscesses

3.3.2 Exclusion Criteria

Patients with prior percutaneous interventions.

3.4 Sampling Method

Census method was used as the number of patients with intra-abdominal abscesses who undergo percutaneous drainage in MTRH yearly is approximately 50. Therefore, all patients who underwent percutaneous drainage due to IAA between Jan to Dec 2020 were included in the study to describe their indication and outcomes.

3.5 Sampling technique

Consecutive sampling was used to recruit participants into the study.

3.6 Study procedure

Patients who showed signs and symptoms of IAA and who required drainage from the interventional radiology room were screened using ultrasonography by the principal investigator. Confirmation on presence of the abscess with correlation of the history provided by the patient was done by the interventional radiologist the probable etiology identified with the help of the history provided for by the patient. The diagnosis made was used for classification. All those with confirmed IAA were recruited into the study and consent sought. All these patients with confirmed IAAs were booked and billed prior to recruitment into the study as per the hospital protocol for the charges of the procedure including waiving for inpatients. Information on the age and sex at the time of procedure was also be obtained. All the patients' files were also reviewed. For those who had a CT scan done as a mode of investigation prior to diagnosis of the procedure, their reports were assessed by the principal investigator and the interventional radiologist and reviewed to confirm the diagnosis and to classify the location of the abscesses. Patients were assessed for any contraindications which included uncorrected coagulopathy, clinical instability and lack of safe access to a collection. All PCD fixation were done by the interventional radiologist assisted by the principal investigator. Treatment was then instilled via percutaneous drainage in accordance to the guidelines after complete diagnostic evaluation by the interventional radiologist that included confirmation via the clinical symptoms and imaging confirmation via ultrasonography.(Radiology, n.d.) and criteria for consideration included, a well-defined abscess cavity, a safe percutaneous route, concurring surgical consultation and immediate operative capability. (Gerzof et al., 1981). The principal investigator assisted in all the patients who had PCD fixation for IAAs recruited in the study. Under local anesthesia and discretionary premedication, a 4 mm incision was made and then widened by (Gerzof et al., 1981) Technique for PCD was either done via the tandem trochar method (One step technique) or the seldinger technique (Two step) for deep IAAs. One step technique was done for superficial collections and small-sized drains while the seldinger technique was used following diagnostic aspiration performed under US guidance; (Radiology, n.d.) however the trocar technique has been advocated for endocavitary drain placement to avoid the risk of loss of access during the process of serial dilation.(Lorenz & Thomas, 2006a) The exact cutaneous entry site and proposed catheter route were meticulously planned prior to needling and were based on the size, location, and anatomic relation of the abscess to surrounding structures as shown by ultrasound scan. The depth for needle aspiration was the shortest distance from the entry site to the near wall of the abscess to avoid perforation of the far wall. (Gerzof et al., 1981)

A sample of the aspirate from each patient was collected, in a sample bottle, labelled and taken to the lab together with a lab request form for gram stain and culture for evaluation. A successful procedure was defined as one that resulted in a comfortable patient leaving the interventional radiology department with a drained abscess and the drain catheter still connected (Radiology, n.d.) and that there was improvement of clinical wellbeing of the patient, and reduction of the size of the cavity on repeat imaging. (John A. Kaufman, n.d.)A successful percutaneous drainage was defined as one that resulted in the complete resolution of both symptoms and the abscess collection. Postoperative hospital stay was calculated using the dates of the PCD and the date of discharge. As per the department protocol all patients were required to present to the department the following day for review and similarly on day 3. In-hospital follow-up was essential after catheter placement, as adjustments in catheter position and catheter number are occasionally required to ensure clinical improvement in the patient’s condition. The timing of catheter removal was based on the clinical condition of the patient and the daily output from the catheter. (Maher et al., 2002). The catheter was removed when there was improvement in clinical well-being of the patient and resumption of appetite; when there was defervescence and normalization of white cell count’ when the catheter drainage was <15 mL per day and when there was disappearance or reduction in size of collection on repeat imaging.

3.6.1 Patient Preparation

Prior to percutaneous drainage, all patients were prepared by carrying out a coagulation profile, a triple serology and a full hemogram. In the wake of Covid 19 a Covid 19 PCR test was included as screening tool for all patients prior to the procedure. These are part of the requirements for all patients prior to carrying out PCD.

The coagulation screen included prothrombin time and INR. PT had to be more than four seconds and the International Normalized Ratio had to be less than 1.5. This was done to avoid or anticipate any complications that may occur during the procedure. Any patient with deranged factors was deferred until stable depending on the lab findings.

It was recommended that broad- spectrum antibiotics be administered to the patients at least one hour prior to the drainage.

If the patient required sedation mostly children, the patient was asked to fast for at least eight hours prior to the procedure. However, sedation was not carried out for majority of the patients in the study. The procedure was done under local anesthesia (2% lignocaine) for all patients including the patients who were sedated to assist with pain relief after the procedure.

After the procedure, four hours of observation was recommended to assess for complications. Immediate complications were assessed at this stage. The patients were then required to be reviewed after 24 hours and on day 3 for possible discharge. Follow up for complications was however done by the principal investigator for up to a week via phone consultation. The cost of this was incurred by the principal investigator.

3.7 Technique

Two techniques were used.

i. Tandem Trochar Method (commonest)
ii. Seldinger Technique

For the Tandem trochar method, it relied on the placement of a catheter containing a hollow stiffener and a diamond pointed stylet, parallel to a guide needle into a collection. Trochar catheters are available from 8 to 16Fr in size and this range of sized catheters were what was used to drain the IAAs. The interventional radiologist used a hydrophilic coated ultra-thane catheter with a locking loop for image-guided drainage. The distance from the skin surface to the abscess was measured and a 18G guide needle of appropriate length chosen. The portion of the needle outside the skin needed to be long enough to guide the trajectory of the catheter. Following cleansing and local anesthetic administration, the catheter was placed through the skin into the collection and a sample obtained for culture. This sample also allowed assessment of the viscosity of the collection, but the collection was not aspirated further until the catheter was placed appropriately. A 10–12Fr catheter was usually necessary if the contents were frank pus; an 8–10Fr catheter was adequate for less viscous fluid. The distance from the skin to the contents of the collection was marked on the catheter. Following a skin incision and tissue separation adjacent to the guide needle, the catheter was introduced parallel to the guide needle, to the level of the mark on the catheter. The catheter was then advanced over the stiffener or the stiffener withdrawn, and the retention pigtail formed.

Once adequate catheter position was confirmed, the contents of the collection were evacuated, the catheter was secured to the skin with an adhesive device and a drainage bag was attached. Catheter irrigation at the time of abscess drainage using normal saline was done to increase drainage yield, disrupt adhesions and improve healing time. However, the volume of normal saline injected didn't exceed that of the fluid drained from the collection to prevent cavity distension and reduce the risk of bacteremia. (*Grainger & Allison's Diagnostic Radiology 5th Ed 2008*, n.d.-b). The mean duration of catheter drainage was about three days. (vanSonnenberg et al., 1982)

For the Seldinger technique, this allowed more controlled catheter placement, especially if there was high risk of catheter transgression of the posterior wall of a collection and facilitated better drainage of large multiloculated collections by placement of a multi-sidehole catheter.

A 19G ultrathin needle containing a stylet or a sheathed needle was initially placed into the collection. An 0.035-inch guidewire was advanced through the needle or sheath and, once adequate positioning was confirmed, the tract was serially dilated. Ultrasound-guided catheter insertion was performed under direct guidance following skin preparation. A guide needle was not necessary unless one wished to sample contents of the collection to assess consistency before choosing the catheter size. (*Grainger & Allison's Diagnostic Radiology 5th Ed 2008*, n.d.-a)

For both techniques the trochar and seldinger techniques, drainage catheters were flushed with normal saline every 8–12 h to maintain catheter patency and optimize drainage. A flush volume of 5 millimeters towards the patient and 5 millimeters towards the drainage bag via a three-way stopcock is normally sufficient unless a collection is very small or very large. Daily catheter outputs were monitored, and the contents of the drainage bag noted. Catheter removal was considered in a well patient when daily outputs were low, normally on the order of 10 millimeters or less per day or when any if present associated fistulas had closed. Before catheter removal it was necessary to confirm complete drainage of the collection by CT or ultrasound imaging and confirm that the cavity had collapsed around the catheter and that there was no fistula present by fluoroscopic-guided injection. Catheter removal at this stage was followed by complete collapse of the cavity. (*Grainger & Allison's Diagnostic Radiology 5th Ed 2008*, n.d.-a)

Follow up was done, abscess features and the clinical status were recorded for the patients before and after the procedure.

INTERVENTIONAL RADIOLOGY PROTOCOL FOR PERCUTANEOUS ABSCESS DRAINAGE

Introduction

Percutaneous abscess drainage (PAD) is now standard therapy for patients with intraabdominal abscess who do not have other indications for surgery. Most collections or abscesses can be managed with an appropriately sized and positioned catheter. (Radiology, n.d.).

Diagnostic criteria

Clinical diagnosis:

This is the most important criteria for referral for PAD. Patients feel unwell, have swinging pyrexia, and have associated abdominal pain and tenderness.

Laboratory diagnosis:

C-reactive protein and leukocytosis reflects the degree of sepsis and is useful for decision making

Imaging:

Clinical suspicion of an intraabdominal collection/abscess is often confirmed with imaging

Planning:

Assess pre-intervention imaging (preferably CT) in multiplanar formats to identify anatomical location of abscess and plan guiding modality and access route.

Assess abscess content for guidance on size of catheter required. It is desirable to distinguish between phlegmonous change (likely unsuccessful drainage) and an abscess with an enhancing wall, although sometimes a needle aspirate is necessary to differentiate between the two.

Choosing the modality for guidance: – US: easier, cheaper, provides real-time guidance, ideal for superficial collections or for angled access, and provides more information about abscess content. – CT with or without CT fluoroscopy: Safer, avoids bowel, and better for deeper abscesses and those which contain gas.

Gas locules deep within collection that has not risen to the top implies thick material or loculation. – Fluoroscopy – useful, underutilized – particularly for repositioning drains (using wires and torqueing catheters) to drain difficult locules or to finalize drain position after US or CT-guided access. Also, it is useful to perform abscessograms

Checking for Indications/Contraindications:

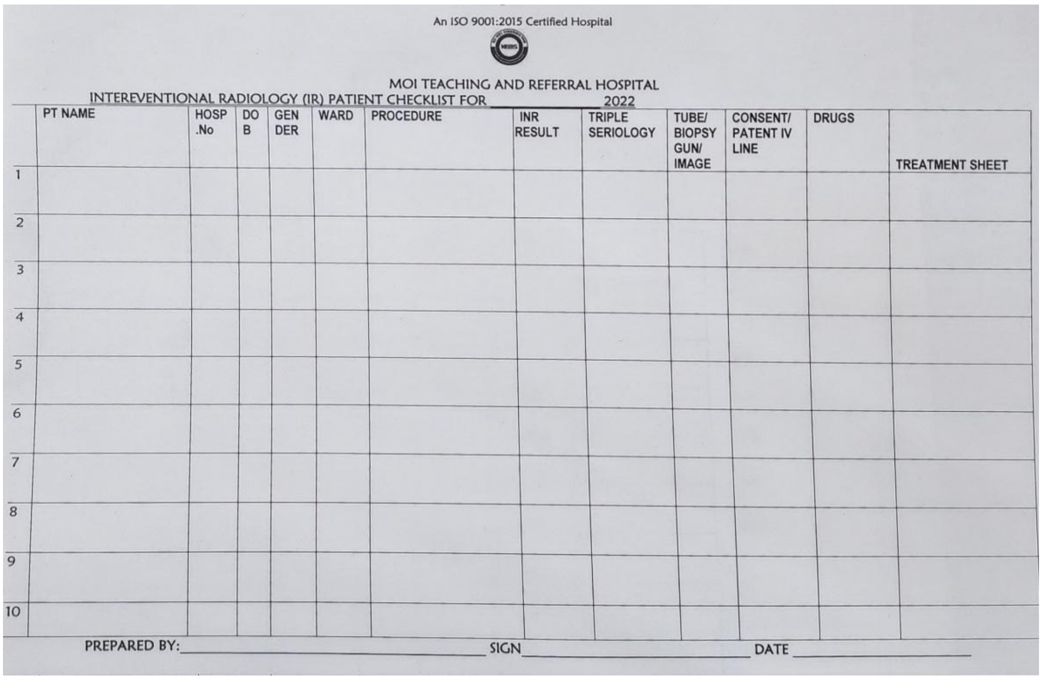
These are relative and depends on the acuteness and severity of the sepsis. Generally, an abscess <4cm should not be considered for PAD unless the patient is septic attributable to the collection

Multiple or multiloculated abscesses may be better dealt with by surgery

Patient preparation:

Broad spectrum antibiotics should be administered intravenously if the patient is not already receiving antibiotic therapy.

Checklist should be filled.



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MOI TEACHING AND REFERRAL HOSPITAL

INTEREVENTIONAL RADIOLOGY (IR) PATIENT CHECKLIST FOR ____________ 2022

	PT NAME	HOSP .No	DO B	GEN DER	WARD	PROCEDURE	INR RESULT	TRIPLE SERIOLOGY	TUBE/ BIOPSY GUN/ IMAGE	CONSENT/ PATENT IV LINE	DRUGS	TREATMENT SHEET
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

PREPARED BY:________________ SIGN________________ DATE ____________

Interventional radiology (IR) is a fast-developing discipline with procedures and equipment getting more advanced and complicated by the day. Increasingly invasive procedures are being performed in a wide variety of patients, many of whom have not been evaluated by the interventional radiologist before the intervention. In IR, as in all medical disciplines, the need for improvements in quality and patient safety is increasingly being recognized. Standard operating procedures are useful and important but do not contribute to a more systematic workflow; nor do they cover the entire pathway of an intervention. Checklist have recently become an important aspect of patient management in IR. (Koetser et al., 2013)

The importance of safety checks has long been recognized in other areas, including aviation and other high-risk industries. In 2000, the Institute of Medicine recommended the implementation of verification processes, such as checklists, into medical practice to standardize processes and decrease reliance on human memory. Recently, the World Health Organization has introduced a safety checklist in the operating room that reduces the rates of death and complications associated with surgery. An even greater effect on mortality and complications in hospitals with high standard of health care quality is seen after implementation of the SURgical Patient Safety System (SURPASS) checklist that covers the entire surgical in-hospital pathway. (Koetser et al., 2013)

Because IR shares several features with surgery, a checklist may be equally effective to improve patient safety in IR. Recently the Cardiovascular and Interventional Society of Europe published a checklist for IR. This checklist was modified from the World Health Organization surgical safety checklist and the RADiological Patient Safety System (RADPASS) checklist. The RADPASS checklist was the subject of a study done by Koetser et. al that was the first validated safety checklist for the complete pathway of radiological interventions. The aim of the study was to design a specific checklist for IR, and to assess the effect of this checklist on health care processes of radiological interventions. It showed that the use of the RADPASS checklist reduced deviations from the optimal process by three quarters and was associated with less procedure postponements. (Koetser et al., 2013)

Procedure

Planning an Access Route

Generally, the safest, straightest, shortest route to the largest part of the abscess is chosen.

Think about patient comfort.

Plan to place the catheter in the most dependent part of the abscess.

Plan such that there is potential to withdraw the catheter to drain more superficial parts of the abscess.

Aim for long axis of collection if possible and change angle of approach as necessary.

If significantly angled access – use US or angle the CT gantry.

Some loops of bowel can be displaced by compression with US probe during access.

Use color doppler to avoid vessels.

Hydro dissection can also be used to create a safe access.

Accessing subphrenic collections can be difficult due to the risk of pleural transgression and resulting pleural infection. It is best to choose a low (subcostal if possible) anterior extra pleural access.

A combination of US and fluoroscopy can be very useful in this setting.

However, trans pleural access is sometimes inevitable and in fact has been shown to be equally effective.

Surgical drain tracts can be used for access.

It is usually safe to transgress liver or stomach for life threatening subhepatic, Para duodenal, gall bladder bed, or lesser sac abscesses.

Avoid large liver vessels, dilated bile ducts, gallbladder, or large peri gastric vessels.

For the completely inaccessible interloop abscess – consider aspirating abscess to dryness transgressing bowel with a 20G needle to provide a sample

Tips:

If drainage is contemplated, do not aspirate too much fluid.

Use a curved wire – occasionally even the blunt end of a straight wire will penetrate the posterior wall of a thin abscess.

Angle access if possible, to avoid hitting the posterior wall of the abscess at right angles, particularly for shallow ones.

Use a dilator only to penetrate the anterior wall after measuring it – too deep dilatation can kink the wire or perforate the abscess.

In larger catheters one can increase the number of side holes to drain a longer segment.

Biloculated collections can be drained by inserting an internal-external drain or withdrawing catheter after deeper locule has been drained.

Consider putting two (or three) drains in large or loculated abscesses.

Consider a peel away sheath when inserting large catheters and there is a risk of kinking.

Mechanical disruption of thin loculi is possible with a pigtail catheter.

Be wary of resolving hematoma or necrotic tumor simulating an abscess – if in doubt, aspirate first. If material is not aspiratable, consider a core biopsy.

Image the collection immediately after drainage to make sure there are no undrained locules.

Endpoint: A comfortable patient leaving the interventional suite with an almost completely drained abscess and the drain catheter still connected! Immediate post-procedure care: Send a nursing post-care form with standard instructions to monitor pulse, blood pressure, temperature and prescribed analgesia. Position the patient to make the drain dependent. IV fluids may be required.

Approaches

Transabdominal (TA) approach: Generally shortest route, most easily tolerated by patients

Trans gluteal (TG) approach: To access to deep pelvic structures obscured by anterior bowel. Must choose route close to sacrococcygeal margin to avoid neurovascular structures. Often painful approach

Transrectal (TR) approach: To access prostatic abscess or collections anterior/posterior to rectum

Transvaginal (TV) approach: To access pelvic collections anterior to rectum

TV/TR catheters have highest risk of falling out

Follow-Up and Post-Procedure Medications: These include analgesia and antibiotics. Post-procedure patient and drain care: This should ideally be supervised by the interventional team. The patient’s temperature, laboratory data (gram stain, cultures, WCC) is monitored daily along with the drainage amount.

The exit site, catheter condition, and integrity of retention are monitored. Catheter irrigation is also supervised.

Communication with and educating ward nurses and clinical team is critical.

Equipment list;

General

US equipment; 2 - to 12-MHz transducer (location dependent), Sterile probe cover/gel

Fluoroscopy equipment.

CT equipment, Radiopaque grid, Trocar technique - 8- to 14-Fr trocar-mounted locking pigtail catheter, Tandem trocar technique - 20-g Chiba guiding needle - 8- to 14-Fr locking pigtail catheter.

Seldinger technique

Access needle (e.g., 18-g needle, 18-g Longdwell needle, 19-g ultra-thin Chiba needle)

0.035" guidewire with 3-mm J-tip – 8- to 14-Fr

Dilators as appropriate – 8- to 14-Fr locking pigtail catheter

TV or TR approach

Endovaginal/endorectal transducer

Sterile probe covers and rubber bands

Sterile gel

Plastic protector for locking pigtail catheter

Speculum for TV approach

Paracentesis or thoracentesis:

18- to 22-g spinal needle (diagnostic aspiration)

7-Fr curved-tip catheter (therapeutic aspiration)

Imaging modality specifics

CT guidance

Perform preliminary scan with radiopaque grid

Plan access route; change patient position if necessary, to avoid intervening structures

Mark entry site on skin

Administer 1% lidocaine local anesthetic

Make dermatotomy with #11 scalpel blade

Advance access needle into collection

18-g Chiba/ring needle (planned Seldinger technique)

20-g guiding needle (planned tandem trocar technique)

Aspirate small amount of fluid; inspect color, purulence, viscosity

Select catheter size; large/viscous collections more effectively drained by larger catheters (12-14 Fr)

US guidance:

Apply gel on probe: Place sterile cover on transducer

Apply sterile gel externally over probe cover

Image target collection; reconfirm planned route

Apply 1% lidocaine local anesthetic

Make dermatotomy with #11 scalpel blade

Advance access needle into collection

18-g Chiba/ring needle (planned Seldinger technique)

20-g guiding needle (planned tandem trocar technique)

Aspirate small amount of fluid; inspect color, purulence, viscosity

Select catheter size; large/viscous collections more effectively drained by larger catheters (12-14 Fr)

Fluoroscopic guidance:

Access usually obtained with US guidance

Needle advancement as described above

Contrast can be injected to confirm borders of collection and to look for fistula

Follow with Seldinger or Trocar technique

Seldinger technique may allow wire to track from superficial collection to deeper communicating space

Approach specifics;

TG approach:

Needle entry site as close as possible to sacrococcygeal margin to avoid neurovascular structures

Use infrapiriformis approach if possible (less painful)

Angling gantry may help achieve best access

TV and TR approach

Consider Foley catheter to decompress bladder

Perform preliminary imaging with endovaginal/endorectal probe

Verify adequate visualization of collection

Doppler to assess for intervening vessels

TV:

Wash vaginal vault with preparatory solution

Place sterile probe cover; secure with rubber band

Use plastic protector in which pigtail catheter packaged as guide and needle/catheter holder

Shorten protector so catheter will protrude 5 cm

Cut longitudinal slit along length of protector

Attach plastic protector to probe; secure with distal and proximal rubber bands.

Place 2nd sterile probe cover over assembly.

Insert probe assembly into vagina/rectum.

Visualize collection; confirm safe path with Doppler.

Aspiration may be performed initially with needle; advance 20-g needle through plastic protector attached to probe into collection under real-time US, aspirate fluid.

Load 8- to 10-Fr locking pigtail catheter onto inner cannula and sharp stylet (trocar).

Advance catheter assembly through plastic protector into collection.

Unscrew trocar; advance catheter 2-3 cm while holding trocar in place; allow pigtail to form.

Remove sharp stylet.

Cut distal rubber band and peel off outer sterile probe cover.

Remove probe; cut remaining rubber band.

Peel off plastic protector.

Remove inner stiffener from catheter.

If aspiration only, aspirate all fluid, confirm with US, and remove catheter.

If indwelling catheter is to be left in, secure to medial thigh.

Specific applications:

Adnexal collections;

Gynecologic consultation prior to aspiration/drainage in suspected malignancy

Aspiration: Only of tuboovarian abscesses

May be effective, but drainage is generally preferred to avoid need for repeat procedure

Ascites

Most common causes: Cirrhosis, malignancy.

Determine lab tests to send on aspirated fluid.

Most common: Gram stain, cytology, fluid cell count, culture, albumin, protein.

Use US to document fluid location/volume/depth.

Choose site with largest fluid volume, no intervening viscera Most common location: Right lower quadrant.

Color Doppler to assess for intervening vessels (e.g., inferior epigastric).

Administer local anesthetic from skin to peritoneum.

Aspirate fluid to confirm in peritoneal space.

Diagnostic paracentesis, 18- to 22-g spinal needle.

Small-volume ascites: Advance needle under real time US guidance.

Large-volume ascites: Mark skin entry site selected by US and advance needle.

Therapeutic paracentesis: Cirrhotic patients may have hemodynamic consequences from large-volume tap; may require serum albumin resuscitation after.

Consider 5 L maximum volume aspirated for 1st time paracentesis and in cirrhotics.

Nick skin with #11 scalpel blade at entry site.

7-Fr curved-tip catheter loaded on trocar.

Advance catheter-trocar assembly using US or by measured depth. Peritoneal puncture delineated by "pop".

Unscrew catheter from trocar, advance into peritoneal space.

Attach 3-way stopcock and extension tubing.

Obtain diagnostic specimens by 3-way stopcock.

Attach tubing to vacuum-drainage bottles.

Kidney

Obtain fluid creatinine in suspected urinomas.

If urinary obstruction/persistent drain output.

May require nephrostomy/ureteral stent or nephroureteral catheter.

Liver

Pyogenic abscesses/bilomas most drained hepatic collections.

Refractory echinococcal cysts may be drained after 2 weeks of medical therapy.

Refractory amebic abscesses may also be drained.

Avoid pleura, large vessels, dilated ducts.

Angling gantry may help achieve optimal access.

Obtain bilirubin on perihepatic collections to confirm/exclude biloma.

Pancreas

Pseudocysts

> 5 cm; enlarging or symptomatic

Aspiration to assess for infection

Drainage may be performed for infected or symptomatic collections

Phlegmon may be too viscous for drainage

Temporizing before surgery

Send fluid amylase on peripancreatic collections

Subphrenic collections

Consider US with fluoroscopy vs. CT for guidance

Pleural transgression may be unavoidable

Angling CT gantry may provide optimal access

Check for pneumothorax on post-CT images

Avoid transgression of lung parenchyma

Check amylase if left subphrenic fluid collection

Post drainage

Irrigation

Attach 3-way stopcock/drainage bag to catheter

Aspirate all contents from cavity

Irrigate with sterile normal saline

Irrigant volume should be less than cavity size

Overdistention risks bacteremia

Irrigate until clear or blood-tinged aspirate

Repeat US or CT

Confirm all fluid drained

Undrained fluid may be due to loculation; may require additional catheters

Catheter fixation

Internally secured by locking pigtail

Externally secured by Commercial fixation device or piece of tape placed around catheter near entry site; sutured to adhesive disk placed on skin

Alternative Procedures/Therapies

Surgical, Laparoscopic drainage, Open surgical drainage

Others, Endoscopic aspiration/drainage, Peripancreatic fluid collections (e.g., pseudocysts)

Things to Do

Send sample to lab; request studies based on differential diagnosis

Abscess: Gram stain, culture, sensitivity

Biloma: Bilirubin

Peripancreatic collection: Amylase

Urinoma: Creatinine

Record drain output per shift

Flush catheter with 10 mL normal saline every 8-12 hours

5 mL to cavity; 5 mL to drainage bag via 3-way stopcock prevents clogging of catheter/tubing

More frequent flushes if fluid tenacious

Always flush after aspiration

Follow-up Gram stain and culture

Things to Avoid

Repetitive CT imaging - Consider clinical scenario/impact of additional imaging on catheter management

May have substantial cumulative radiation dose (e.g., patients with inflammatory bowel disease, recurrent pancreatitis, biliary obstructive disease)

Do not remove catheter early if:

Undrained fluid, persistent output, persistent fever, leukocytosis

Outcomes

Problems

Low drainage output

> Consider potentially dislodged/malpositioned drainage catheter, undrained loculations, tenacious fluid or phlegmon.

Reimage if low drainage output and persistent fever, leukocytosis, or hemodynamic instability

Consider contrast injection under fluoroscopy; if malpositioned

Reposition drain over guidewire

Place new drain if tract not salvageable

If fluid viscous, exchange and upsize drain

Use catheter with as many side holes as possible; higher clinical success rate with more side holes

Deliver intracavitary tissue-type plasminogen activator (tPA) - Useful for viscous contents and persistent fluid collection despite good catheter position. Success rate > 80% in such collections – 4-6 mg tPA in 25 mL sterile normal saline. Instill tPA into cavity; clamp catheter for 30 min. Unclamp and do not aspirate. If multiple catheters in collection, divide dose. May be used even if systemically anticoagulated.

Persistent high drainage output

Likely related to fistula
Management requires patience, often months
Octreotide for pancreatic fistula
Address any downstream obstruction

Expected Outcomes

Reported clinical success of abscess drainage > 90%
Lower probability of success with certain collections e.g. multiloculated
Phlegmonous, Associated with fistula/downstream obstruction.

Prognostic factors associated with primary failure

High residual volume of fluid after drainage

CT attenuation > 20 HU

Presence of fistula (Dr. Vladimir, 1967)

Further intervention is necessary when:

Fever persists - repeat imaging or perform drainogram under fluoroscopy. Repositioning or further catheters may be necessary.

Catheter has fallen out: If the tract is a few days old it is usually possible to reenter the tract with a catheter and a hydrophilic guide wire.

Catheter is blocked or kinked: Most kinks are outside the body - in the dressings! Flushing with saline or manipulating with a guide wire usually clears a blocked catheter. If reinserting the wire is difficult, one can put an oversheath over the catheter after removing the hub and replace a new catheter.

Tips to drain viscous collection

Gently flush drain with 20 mL saline two to three times a day.

Use a sump drain

Use urokinase or tPA – the former at 50,000 IU in saline thrice daily with 15 min clamp and release (Haaga protocol).

Urokinase is not approved by the FDA - use tPA instead: 4–6 mg tPA in 25 mL of normal saline instilled thrice daily, catheter clamped for 30 min, then drained, for 2–3 days. This cycle can be repeated.

Removal of drain

Resolution of fever/leukocytosis

Daily drainage <20ml/day and source of sepsis controlled

Imaging shows resolution of abscess

Catheter-related problems like malposition, kinking or blockage

If trans pleural access is used in subphrenic abscess, ensure that the tract is mature before removal to prevent contamination of pleural cavity. A tractogram can be performed before removal.

Causes of Failure

Persisting fistulous communication - perform drainogram to confirm

Early removal of drain - after acute sepsis subsides. It is preferable to image prior to removal if in doubt.

Collection is loculated - consider multiple drains, tPA, or surgery

Fungal infection

Crohn's disease – PAD first line, but, one-third require surgery

Misplaced catheter

Inappropriate site of entry

Alternative Therapies:

The principle alternative therapy is surgery (if associated with large visceral perforation, failed PAD, multiloculation, or multiple abscesses) or conservative treatment with antibiotics (if smaller than 4 cm, low-grade pyrexia and/or patient clinically recovering).

Complications:

Peritonitis 2%

Septicemia and bacteremia 1–5%

Hematoma and vascular injury 2%

Pneumothorax

Pleural effusion 2–10%

Empyema Bowel injury 1%

How to Avoid

Avoid perforating the posterior wall of the abscess

Do not flush too vigorously - this may allow venous contamination and septicemia

Avoid transgressing the pleura

Allow tract to mature before drain removal

Use color doppler to avoid vessels

Who does what during the procedure?

Interventional Radiologist - Performs the PCD

Registrar – Assists the Interventional radiologist carry out the procedure

Nurse – Assists in providing the necessary equipment needed for the procedure and gives pre and post medications to the patient.

General Preventive measures

A safety checklist must be filled for all patients presenting to the IR unit.

All patients transferred to the IR departments must wear surgical masks same to for the porters.

All professionals working in the department must wear surgical scrubs and surgical masks throughout the work shift.

All professionals must wash their hands frequently.

All workstations must be individualized.

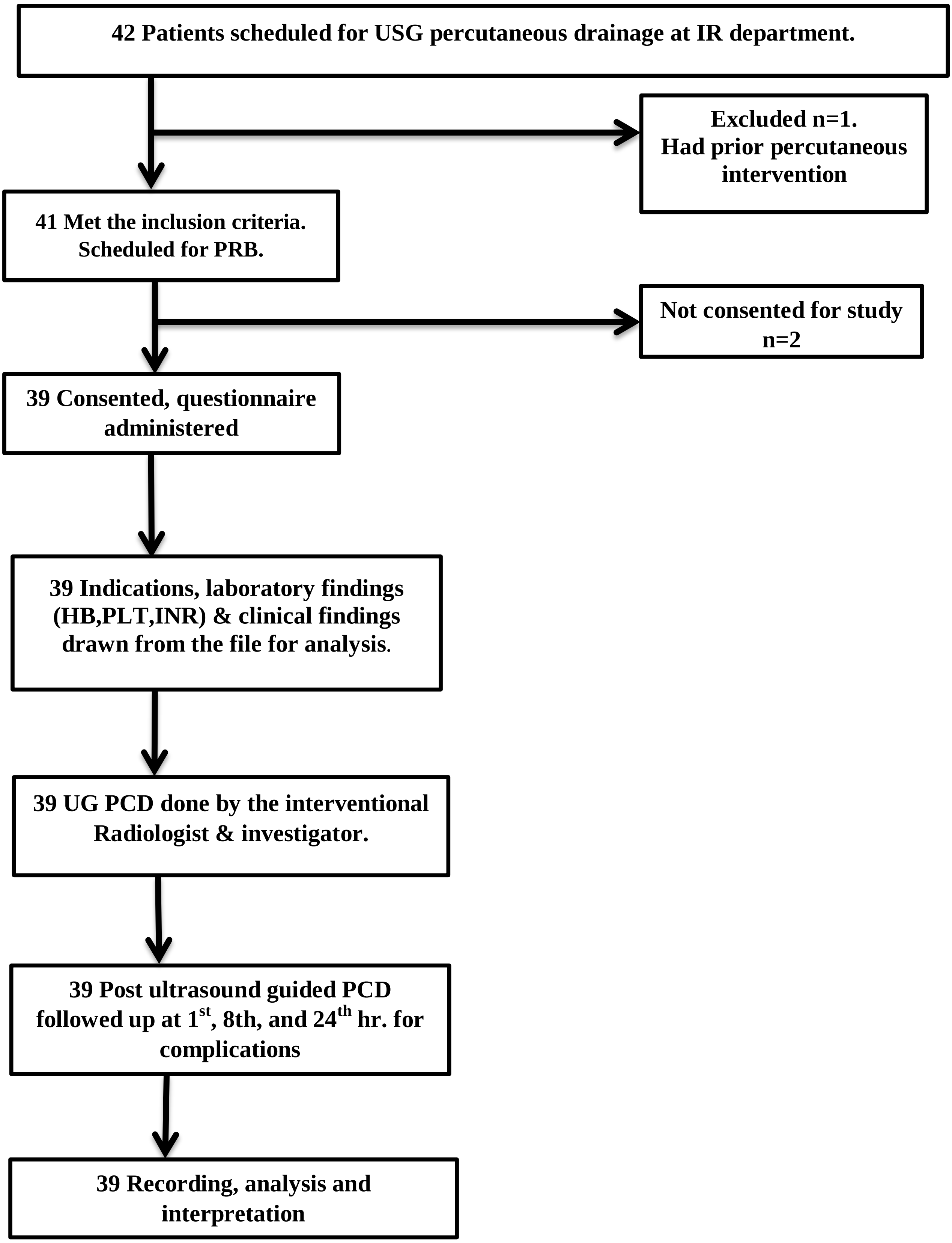
Consultations done from other departments must be done remotely.

PROTOCOL SUMMARY

1. Patient referred to IR with a positive history of having an abscess
2. Patient assessed by the doctor
3. Patient prepared for the procedure
4. Labs done
5. Procedure instruments acquired for the patient
6. Procedure done

7. Follow up done
8. Outcome evaluated

3.8 Recruitment schema



3.9 Data management, analysis and presentation

The data was collected using questionnaires which had no patient's identification. For identification purposes a study number was used instead. The questionnaires were filed in a study file which was kept under a lock and key to ensure confidentiality of information provided was maintained. To improve on the quality of data, the researcher checked on the completeness of the questionnaire daily before entering the data into a Microsoft access database.

Data was imported into SPSS version 24 where coding, cleaning and analysis was done. Descriptive statistics such as mean and corresponding standard deviation, the median and the corresponding interquartile range were used to summarize the continuous data such as age. Frequencies and corresponding percentages were used to summarize categorical data such as sex of patients. The location of IAA and complications were reported in terms of proportions. Comparison between different study categorical variables was done using Chi-square/Fisher's exact test. A p-value of <0.05 was considered statistically significant. The data was presented in form of charts, tables, graphs and prose form.

3.10 Ethical Considerations

The study proposal was sent to Moi University/ MTRH Institutional Research and Ethics Committee (IREC) for review and approval. Permission was sought from the management of MTRH for the study to be carried out at the facility. Informed consent was sought directly from the respondents undergoing the procedure.

Consent: Written consent was sought from patients above 18 years undergoing the procedure while for those below 18 years of age, consent was sought from their parents or guardian or legally accepted representative. Participation in the study was voluntary and the participants were free to withdraw at any time. Confidentiality of the respondents' information was maintained, and codes were used instead of the respondents' names to protect their identity.

Confidentiality: The information provided by the respondents and that obtained from their medical records was kept confidential and was stored in a lockable cabinet. The data was entered into a password protected computer and using codes in place of individual names.

Benefits: There was no direct monetary benefits in the participation of the study. Respondents could withdraw from the study at any time with no need to seek prior authorization or consequences for doing so.

Risks: No major risks existed as a result of participating in the study except the time spent in participation of the study.

3.11 Dissemination of results

The results were presented to department of radiology and imaging, Moi University School of medicine. A manuscript will be prepared and published in a reputable radiology journal. The results will also be presented in local and international radiology meetings, conferences and seminars.

CHAPTER FOUR

4.0 Results

4.1 Patients' demographic characteristics

Table 5: Patients' demographic characteristics.

Variable	Category	Frequency	Percentage
Age	Median (IQR)	40 (25-48)	
Gender	Male	22	56.4
	Female	17	43.6
County of residence	Uasin Gishu	21	53.8
	Siaya	3	7.7
	Nandi	2	5.1
	Trans Nzoia	2	5.1
	Turkana	2	5.1
	Others	9	23.1

The age of patients ranged from 4 to 83 years with a median age of 40 (IQR 25, 48) years. Where the proportion of males was slightly higher (56.4%) compared to females (43.6%). Slightly above half (53.8%) of the patients were residents of Uasin Gishu county while the bordering counties (Elgeyo Marakwet, Nandi, Kakamega and Trans Nzoia Counties contributed 6(15.4%) of the respondents.

4.2 Objective 1: To assess the causative mechanisms and locations of intra-abdominal abscesses.

Table 6: Causative mechanisms

Variable	Category	Frequency	Percentage
Etiology	Postoperative	15	38.5
	Trauma	10	25.6
	Cancer	9	23.1
	Gangrenous cholecystitis	2	5.1
	Pancreatitis	2	5.1
	TB	2	5.1
	Perforation of small bowel	1	2.6
	Perforated appendicitis	1	2.6
	Mesenteric ischemia	1	2.6

Most (38.5%) of the patients with IAA had them as complications following surgery. followed by trauma (25.6%) and cancer (23.1%); these three etiologies contributing to 87.2% of the total (n=39) cases of IAA included in the study.

Table 7: Radiological features

Variable	Category	Frequency	Percentage
Location	Right lower quadrant	12	30.8
	Sub-phrenic	7	17.9
	Psoas	5	12.8
	Peri splenic	5	12.8
	Left iliac fossa	2	5.1
	Anterior abdominal wall	1	2.6
	Supravesical	1	2.6
	Hepatorenal	1	2.6
	Inguinal	1	2.6
	Lesser sac	1	2.6
	Para-vertebral	1	2.6
	Peri-pancreatic	1	2.6
	Prevesicle	1	2.6

Majority (30.8%) of these IAA were located in the right lower quadrant, sub-phrenic constituted 17.9% and psoas represented 12.8% of the sites.

4.3 Objective 2: To assess the clinical and radiological outcomes of percutaneous drainage of IAA.

Table 8: Clinical features

Variable	Category		Frequency	Percentage
Clinical features present	Abdominal pain	Before PCD	37	94.9
		After PCD	10	25.6
	Guarding	Before PCD	19	48.7
		After PCD	1	2.6

Table 9: Radiological outcomes

Variable		Category	Frequency	Percentage
Components		Both fluid & solid	9	23.1
		Purely fluid	30	76.9
Echogenicity		Heterogenous	9	23.1
		Uniform	30	76.9
Content	Before PCD	Pus	29	74.4
		Pus with blood	10	25.6
	After PCD	Light blood	1	2.6
		Serous fluid	33	84.6
		Viscous pus	5	12.8
Inflammatory changes	Before PCD	None	19	48.7
		Minimal	20	51.3
	After PCD	None	38	97.4
		Minimal	1	2.6
Free fluid around abscess	Before PCD	None	28	71.8
		Present	11	28.2
	After PCD	None	38	97.4
		Present	1	2.6
Surrounding vascularity	Before PCD	Low vascularity	27	69.2
		Hyper-vascular	12	30.8
	After PCD	Low vascularity	38	97.4
		Hyper-vascular	1	2.6
Loculations	Before PCD	None	31	79.5
		Present	8	20.5
	After PCD	None	38	97.4
		Present	1	2.6

Clinically, almost all 37(94.9%) of the patients presented with history of abdominal pain prior to the procedure and after PCD only 25.6% of the patients had abdominal pain. Guarding was a presenting feature in about 48.7% of the patients and only 2.6%

of the patients still had guarding post PCD. Other clinical features included hotness of body and abdominal mass on examination.

As per the radiological findings majority (76.9%) of the IAA contained purely fluid material while the rest (23.1%) contained both fluid and solid components. Majority (76.9%) of the IAA were uniform in echogenicity while the rest (23.1%) showed heterogenous echogenicity.

The average size of IAA before PCD was 360 (IQR 200, 580) ranging from 60 to 2000 milliliters. 74.4% of the IAA showed pus before the procedure and 25.6% showed pus with blood. Following the procedure, 84.6% of the IAAs had serous fluid while 12.8% contained viscous pus and 2.6% of them showed light blood.

Most of the IAA (51.3%) had minimal inflammatory changes prior to PCD. After the procedure majority (38%) showed no inflammatory changes.

Before PCD some IAA showed free fluid surrounding them, but these showed marked resolution after the procedure with almost all (97.4%) showing no surrounding free fluid.

Surrounding vascularity was demonstrated to be high before PCD in only 30.8% of the IAA but in both those with high and low vascularity, only 2.6% of the IAA demonstrated high surrounding vascularity after the procedure.

20.5% of the IAA showed loculations before PCD vs 79.5% which showed no loculations; however, after PCD only 2.6% demonstrated loculations.

4.4 Objective 3: To assess complications arising after percutaneous drainage of IAA.

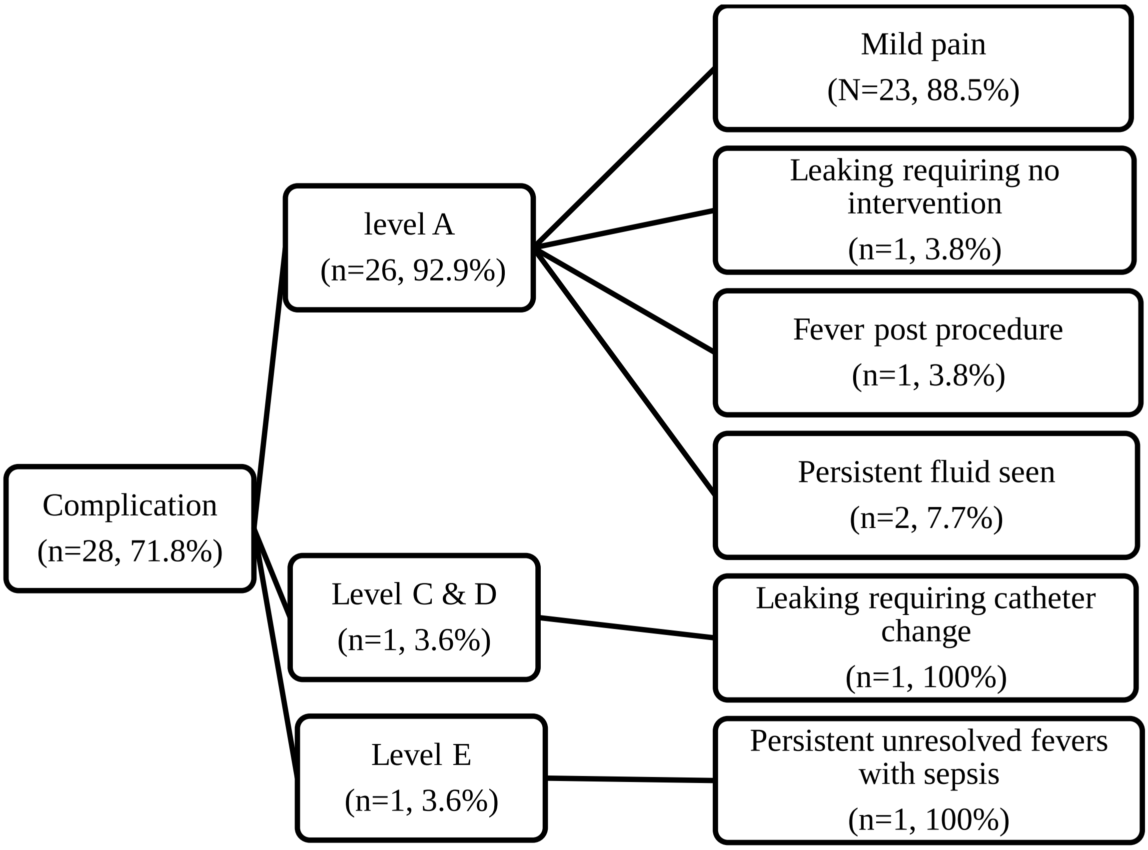


Figure 4: Percutaneous drainage complications

Key*: *Level A *= Minor Complications that required no therapy required*

Level B *– Minor complications that required minimal therapy, which included admission for overnight observation. (The complications included leak around the catheter that did not require change of catheter)*

Level C *– Major complication that resulted in catheter change but did not involve prolonged hospitalization and increased level of care.*

Level D *- Major complication that resulted in catheter change and resulted in hospitalization longer than overnight and increased level of care.*

Level E *– Major complication that led to complete removal of the catheter including persistent unresolved abscess and persistent unresolved leaking.*

Out of the 39 patients included in the study, 28(71.8%) reported to have procedural complications. Of these 28, 26(92.9%) had minor complications that required no therapy (Level A), 1(3.6%) had major complication that resulted in hospitalization (Level C and D) while another 1(3.6%) had major complication that resulted in permanent change of percutaneous catheter (Level E). Majority (88.5%) of those who had minor complications level A; complained of minor pain, 1(3.8%) had a leak requiring no intervention while another 1 (3.8%) had fever post procedural. The one patient with complications level E was reported to have persistent unresolved fevers with sepsis.

4.5 SAMPLE IMAGES

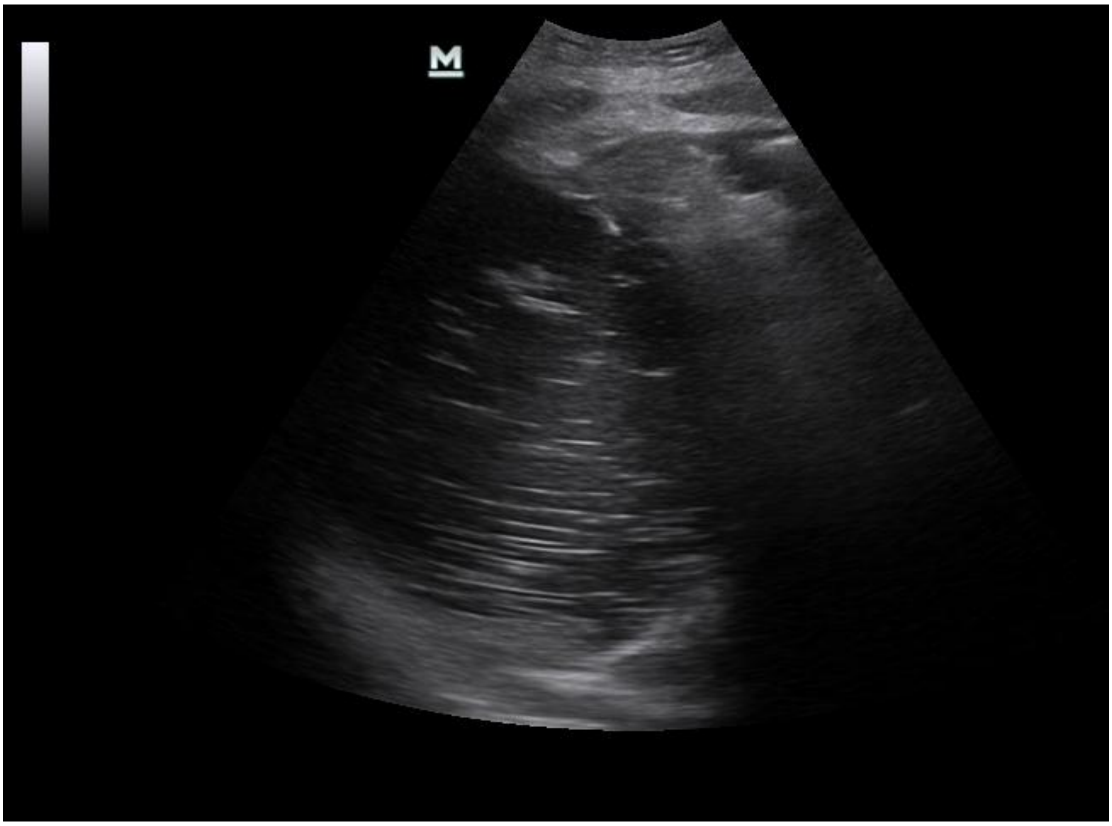


Image 1a: 42-year-old male with an intra-abdominal abscess. Axial transabdominal scan through the right lower quadrant demonstrating a large abscess.

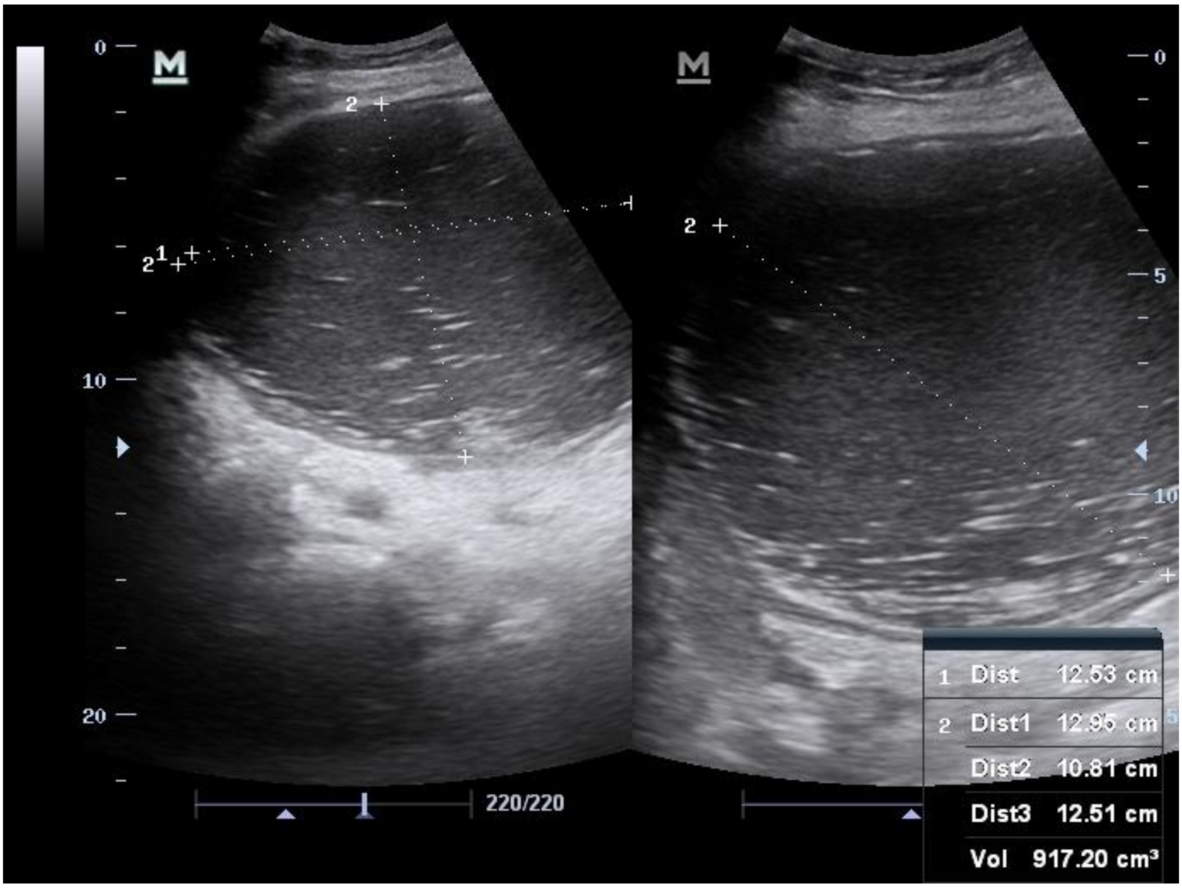


Image 1b: 42-year-old male with an intraabdominal abscess. Axial transabdominal scan through the right lower quadrant demonstrating a measurement of the volume of the abscess (917.2 cm^3)

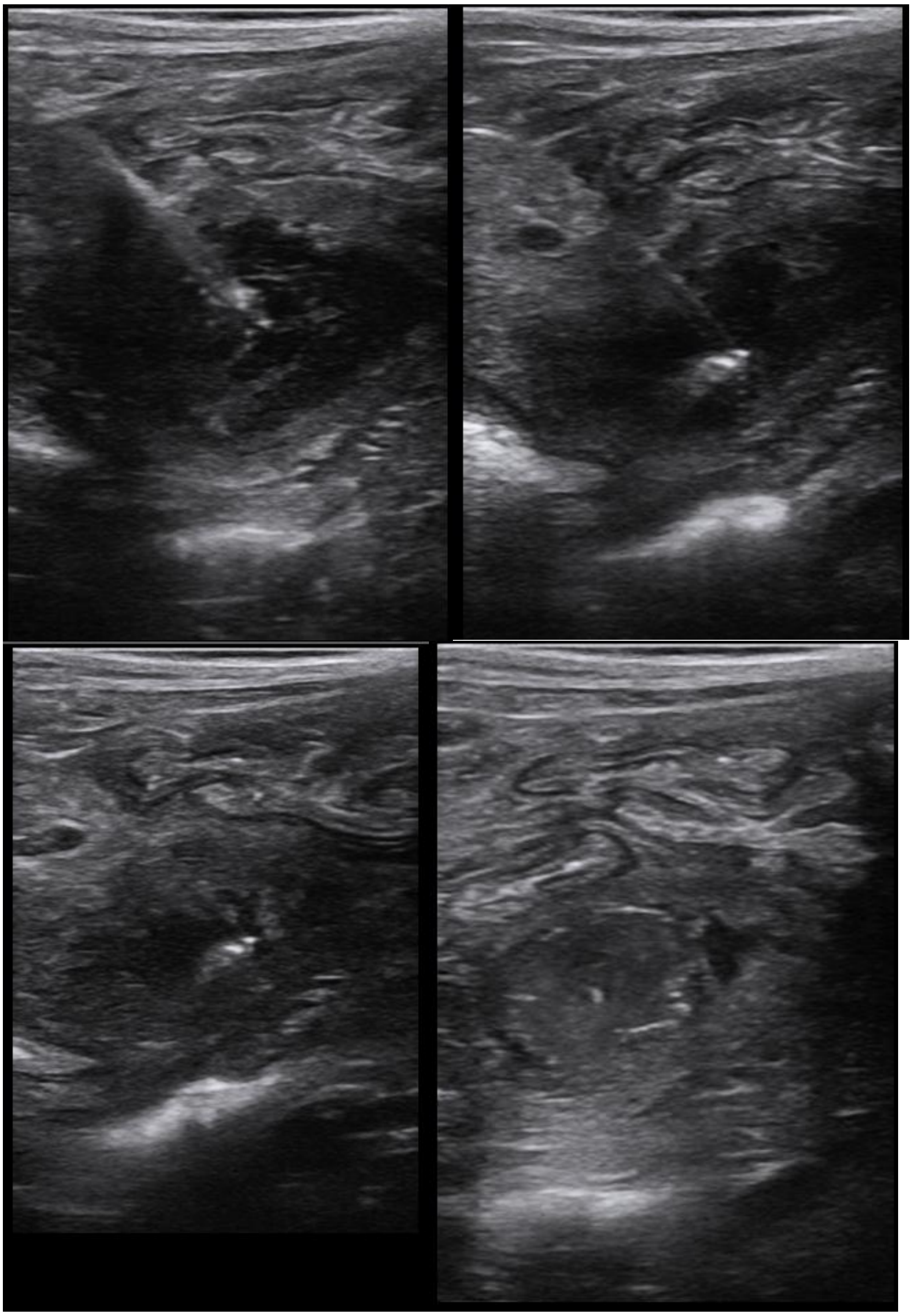


Image 2: 28-year-old female with an abscess in the right lower quadrant. Serial axial transabdominal scan through the right lower quadrant demonstrating PCD with the pigtail catheter in situ, drainage of the IAA and post-procedural reduction in size of the abscess.

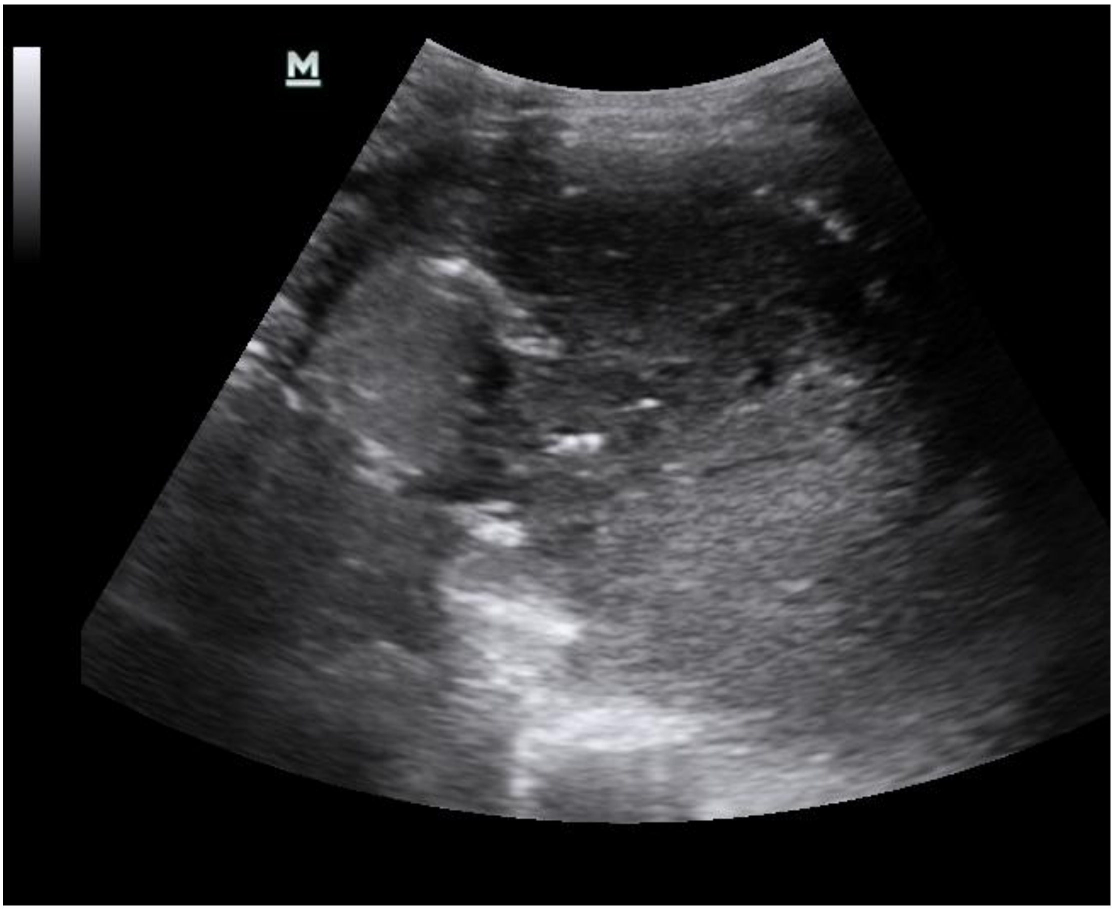


Image 3: 64-year-old male with a subphrenic abscess; axial transabdominal scan through the subphrenic region demonstrating an abscess with both solid and fluid components likely a tumoral abscess.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

Intra-abdominal abscesses are a major contributor to morbidity and mortality around the world. More so in developing countries like Kenya where diagnosis and management are usually carried out late due to factors that include gender, level of education and long waiting time for specialized treatment. In the past and even currently, most of the Intra-abdominal abscesses (IAA) are treated via open surgery. However, with the age of Interventional Radiology, IAA are managed faster, and with better clinical and radiological outcomes.

5.2 Objective 1: To assess the causative mechanisms and locations of intra-abdominal abscesses.

Most (38.5%) of the patients with IAA had them as complications following surgery followed by trauma (25.6%) and cancer (23.1%); these three etiologies contributing to 87.2% of the total (n=39) cases of IAA included in the study.

This corresponded well to a study by Stephen G. Gerzof et al that found majority (67%) of the patients had IAA formation due to surgery (Gerzof et al., 1981). Other studies also showed that most of the IAA were due to surgery including Cinat et al (Cinat et al., 2002) (Yamaguchi et al., 2004) and (Connell et al., 1980). Cinat et. al., demonstrated post-surgical as the most causative mechanism with a mean SD of 22-29 days after operation with majority of the patients showing the abscess on the initial post-surgical scans and the rest developing the abscesses after the initial scans. Yamaguchi et. al., in his study on patients with crohn’s disease demonstrated majority of their patients had a positive history of having had surgery prior and the most common reason as to which his patients required surgery prior was stenosis which is common in crohn's disease.

One study demonstrated trauma as the commonest cause (Nichols, 1986). Nichole et. al., observed that more than 80% of the abscesses occurred after penetrating abdominal trauma and they therefore demonstrated the major importance of gastrointestinal perforation to postoperative infection. They additionally reported the results of a prospective study of 145 patients who presented with penetrating abdominal trauma & intestinal perforation and they also demonstrated the risk of abscess formation being greater with increasing age, injury to the left colon necessitating colostomy, greater requirements for blood or blood products during surgery and increasing number of organs injured. The difference in this study can be attributed to the fact that the study was geared towards treatment of intraabdominal sepsis as opposed to IAA specifically.

Majority (30.8%) of these IAAs were located in the right lower quadrant, sub-phrenic constituted 17.9% and psoas represented 12.8% of the sites. This corresponded well with a study by W. A. Altemeier which showed majority of the IAA located in the right lower quadrant in the peritoneal cavity. (Altemeier et al., 1973). Altemeier et al., more than half of the abscesses were located in the right lower quadrant followed by the left lower quadrant, pelvis and subphrenic areas. They additionally stated that understanding of these anatomic considerations was important for the recognition and drainage of the abscesses.

5.3 Objective 2: To assess the clinical and radiological outcomes of percutaneous drainage of IAA.

Clinically, almost all 37(94.9%) of the patients presented with history of abdominal pain on examination prior to the procedure and after PCD only 25.6% of the patients had abdominal pain. This corresponded well with a CIAOW study that demonstrated abdominal pain, abdominal rigidity and high white cell count as the commonest clinical finding. (Sartelli et al., 2014) It also corresponded well with a study by M. Khurrum Baig et al who found 80% of their patents complaining of abdominal pains. (Khurrum Baig et al., 2002). Their study also demonstrated pyrexia and abdominal mass as additional presenting features and 90% of the patients in their study had leukocytosis at the time of diagnosis. A study by W.A. Altemeier et al demonstrated fever as the commonest symptom, this could be attributed to the fact that most of our patients were on analgesics prior to the procedure. (Altemeier et al., 1973) and their study provided additional features such as chills rapid and thread pulses flushed face and pain expression; the local signs and symptoms varying widely with the location and source of the abscesses. Guarding was a presenting feature in about 48.7% of the patients and only 2.6% of the patients still had guarding post PCD. Other clinical features included hotness of body and abdominal mass on examination. Of note our study compared the clinical findings before and after which was demonstrated in the studies that were in relation to PCD.

The average size of IAA before PCD was 360 (IQR 200, 580) ranging from 60 to 2000 milliliters. A study by W. A. Altemeier et al showed the size of the abscesses ranging from 4ml to 7000mls. (Altemeier et al., 1973). These very large sizes of the IAAs in the study could be attributed to the fact that their study had 540 patients.

As per the radiological findings majority (76.9%) of the IAA contained purely fluid material while the rest (23.1%) contained both fluid and solid components. Majority (76.9%) of the IAA were uniform in echogenicity while the rest (23.1%) showed heterogenous echogenicity.

74.4% of the IAA showed pus before the procedure and 25.6% showed pus with blood. Following the procedure, 84.6% of the IAAs had serous fluid while 12.8% contained viscous pus and 2.6% of them showed light blood. M. Khurrum Baig et al demonstrated residual abscess accumulation in 35% of the patients compared to our study which was at 12.8% of them who had viscous pus after the procedure and these patients were treated by repeat drainage. This difference could be attributed by the fact that the study was only geared at CT guided interventions and ultrasound guided PCD were not studied.

Most of the IAA (51.3%) had minimal inflammatory changes prior to PCD. After the procedure majority (38%) showed no inflammatory changes.

Before PCD some IAA showed free fluid surrounding them, but these showed marked resolution after the procedure with almost all (97.4%) showing no surrounding free fluid.

Surrounding vascularity was demonstrated to be high before PCD in only 30.8% of the IAA but in both those with high and low vascularity, only 2.6% of the IAA demonstrated high surrounding vascularity after the procedure.

20.5% of the IAA showed loculations before PCD vs 79.5% which showed no loculations; however, after PCD only 2.6% demonstrated loculations. This corresponded well with a study by M. Khurrum Baig et al that demonstrated majority 88.5% of the IAA being unilocular while the rest were multiloculated with well defined walls demonstrated in 10% of their patients and the walls being poorly defined in majority of the patients. They additionally studied the number of collections and most of the patients had one collection while the rest had two or three.

5.4 Objective 3: To assess complications arising after percutaneous drainage of IAA.

Out of the 39 patients included in the study, 28(71.8%) reported to have procedural complications. Of these 28, 26(92.9%) had minor complications that required no therapy (Level A), 1(3.6%) had major complication that resulted in hospitalization (Level C and D) while another 1(3.6%) had major complication that resulted in permanent change of percutaneous catheter (Level E). Majority (88.5%) of those who had minor complications level A; complained of minor pain, 1(3.8%) had a leak requiring no intervention while another 1 (3.8%) had fever post procedural. The one patient with complications level E was reported to have persistent unresolved fevers with sepsis. Patients with Level A, B, C and D were still considered as success rates considering that there was post procedural resolution of the abscesses. This therefore means that 1 patient or 3.8% of the patients demonstrated failure of percutaneous abscess drainage with a corresponding success rate of 96.2% This corresponded well with a study by O. Goletti et al that demonstrated a success rate of 94.7% (Goletti et al., 2005) and they additionally demonstrated that multiloculation and the presence of necrotic tissue were the most common causes of failure. It also corresponded well with a study by Giuseppe Civardi in Italy that demonstrated a cure rate of 98.7% (Civardi et al., 1998) with the best results seen in simple, well defined collections and even when compared to surgical group the study reported that the technique was at least as efficacious as operative drainage, but the complication rate was lower. The study also additionally stated that most complications that occurred in their patients were minor and not related to the site of the abscess. A study done by Eric vanSonnenberg et al showed 8.6% had major complications adding that an associated GI communication may require an operation and that the surgeon's task is simplified because if the on-infected bed. The difference in this study may be attributed to the fact that the patients in this study were critically ill and were also deemed unfit for anesthesia (Ferrucci Jr & vanSonnenberg, 1981). One done by Stephen G. Gerzof et al demonstrated an 8.3% rate of major complications, this may be attributed to the smaller number of sample participants as the study was done on 24 patients. (Gerzof et al., 1981)

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Most of the patients with IAA had them as complications following surgery. Clinically most of the patients complained of abdominal pains. Radiologically, only 30% of the IAA were visualized by ultrasound to be hyper vascular. Mild pain was the commonest post procedural complication. Only 1 of the patients had a major complication. Overall success rate of PCD was 96.7%.

6.2 Recommendations

Clinical assessment of patients early; especially post-surgical patients to enable early detection of the IAA. Adequate post procedural analgesia with counselling on the expected complications. Percutaneous drainage be considered as one of the first line treatment options for patients with IAAs owing to its high success rate.

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APPENDICES

Appendix 1: Consent Form

This informed consent form is for patients with suspected Intra-Abdominal Abscess.

Introduction

My name is Dr. Clay Michelle Nyawira from the Department of Radiology and I am carrying out a study on how we can use percutaneous drainage to manage Intra-Abdominal Abscesses. Intra-abdominal abscesses are a major contributor to morbidity and mortality around the world. I am kindly requesting you/your child to participate in the study.

What is the study about?

The study is about percutaneous drainage of intra-abdominal abscess, their clinical outcomes and complications. By you participating in the study you help us further enhance diagnosis and management of IAA.

What will happen to me during the study?

On giving consent, you will be asked a few questions about yourself and your condition. I will then collect information about your clinical signs and symptoms, your laboratory tests and any problems that may arise after the procedure is done.

You will not incur any risks or acquire any benefits by participating in this study. You will be given the same medical care as the rest of the patients who do not participate in the study. You can choose whether or not you would like to participate in the study. In case you refuse to be a part of the study you will not be forced to participate.

If you have any questions, please feel free to ask and I will be glad to assist you.

Certificate of assent

Do you understand this research study and are willing to take part in it?

Yes: ☐ No: ☐

Has the researcher answered all your questions?

Yes: ☐ No: ☐

Do you understand that you can pull out of the study at any time?

Yes: ☐ No: ☐

I agree to take part in the study ☐

OR

I do not wish to take part in the study ☐

Signed: …………………………………………

Date: ……………………………………………

Appendix 2: Kiswahili Version

Mpelelezi: jina langu ni Daktari Michelle Clay. Mimi ni daktari aliyehitimu na kusajiliwa na bodi ya Kenya ya Madaktari na Madaktari wa meno. Mimi sasa natafuta shahada ya uzamili katika Radiology na Imaging katika Chuo Kikuu cha Moi. Ningependa kukuhusisha katika utafiti wangu ambao ni wa dalili na matokeo ya biopsy ya figo kwa kutumia chombo cha ultrasound katika hospitali ya mafundisho na ya rufaa ya moi.

Kusudi: Utafiti huu utajaribu kujua dalili na matokeo ya utolevu wa usaa kwa kutumia chombo cha ultrasound katika hospitali ya mafundisho na ya rufaa ya moi.

Utaratibu:

Wagonjwa watakaotoa kibali kuhusika katika utafiti huu Data ya umri, ngono, (shinikizo la damu, kiwango cha vurugu, zitaandikwa. Kiwango cha hemoglobin, seramu creatinine, vigezo vya msingi vya mwako wa kimsingi (wakati wa prothrombin, wakati wa sehemu ya thromboplastin, wakati wa kutokwa na damu, INR) zitapatikana kutoka faili ya hospitali ya mgonjwa.

Wagonjwa watapelkwa kwenye chumba cha kutolewa usaa na usaa huo utatolewa kwa tumbo kutumia Chombo cha ultrasound.

Baada ya kutolewa usaa tumboni mgonjwa atazingatiwa kwa masaa 8 kwenye chumba cha interventionali radiolojia ya kawaida kwa hematuria, hypotension na hematoma na arteriovenus fistula.

Data zitakusanywa kwenye fomu za ukusanyaji data. Hifadhi zitakazo tumika katika ukusanyaji wa data zitawekwa katika kabati iliyofungwa katika nyumba ya mpelelezi mkuu katika kipindi cha utafiti.

Faida: Kutakuwa hakuna faida moja kwa moja ya kushiriki katika utafiti huu. Wanaofanyiwa utafiti watakuwa nahaki nakupewa ubora sawa na wale ambao hawatofanyiwa utafiti huo.

Hatari: Hakuna hatari ya kutarajia kwa washiriki inatokana na utafiti huu.

Usiri: Habari zote zilizopatikana katika utafiti huu wa kutibiwa zitawekwa kwa usiri mkubwa na wala haitatolewa kwa mtu yeyote asiye husika na utafiti.

Haki ya kukataa: Kushiriki katika utafiti huu ni hiari yako, kuna uhuru wa kukataa kuchukua sehemu au kutoka wakati wowote. Utafiti huu umeidhinishwa na Utafiti wa Taasisi na Kamati ya Maadili (IREC) ya Chuo Kikuu cha kufundisha cha Moi na Hospitali kuu ya Rufaa.

Weka sahihi au kufanya alama kama unakubali kushiriki katika utafiti

Mgonjwa: .... Tarehe: ....

Mpelelezi: .... Tarehe: ....

Appendix 3: Data Collection Form

Instructions:

a) All sections should be filled accordingly.

b) Writings should be clear and legible.

c) The form is to be filled in by the principal investigator or assistant once the patient has given consent to be part of the study.

IP/OP No: ……………………………….

Serial No: ………………………………..

Date: ……………………………………..

PART 1: DEMOGRAPHIC DATA

1. DOB/ Age: …………………………......
2. Gender: ………………………………
3. County of Residence: ……………………………..
4. Patient's Contact No: ……………………………...

PART 2: FINDINGS

SECTION A: Causative mechanisms

Causative Mechanism	**Yes**	**No**
Trauma		
Prick		
Post-operative		
Perforation of viscous		
Perforated appendicitis and diverticulitis		
Gangrenous cholecystitis		
Mesenteric ischemia		
Pancreatitis or pancreatic necrosis		
Missed gallstones		

SECTION B: Radiological findings

Radiological Features	Before PCD	After PCD
Size		
Location		
Contents		
Inflammatory Changes		
Free fluid around or near the abscess and its location		
Surrounding vascularity		
Loculations		
Others…………………...		

SECTION C: Microbiological findings

Microbiological organisms	Findings
Escherichia coli	
Streptococcus species	
Enterococcus species	
Bacteroides species	
Klebsiella species	
Yeast	
Polymicrobial	
Others (Please specify) …………………	

Tick appropriately

Yes = √

No = X

SECTION D: Clinical features and findings

Clinical Features	**Findings**
Hotness of the body	
Abdominal Pain	
Abdominal mass	
History of prior surgery	

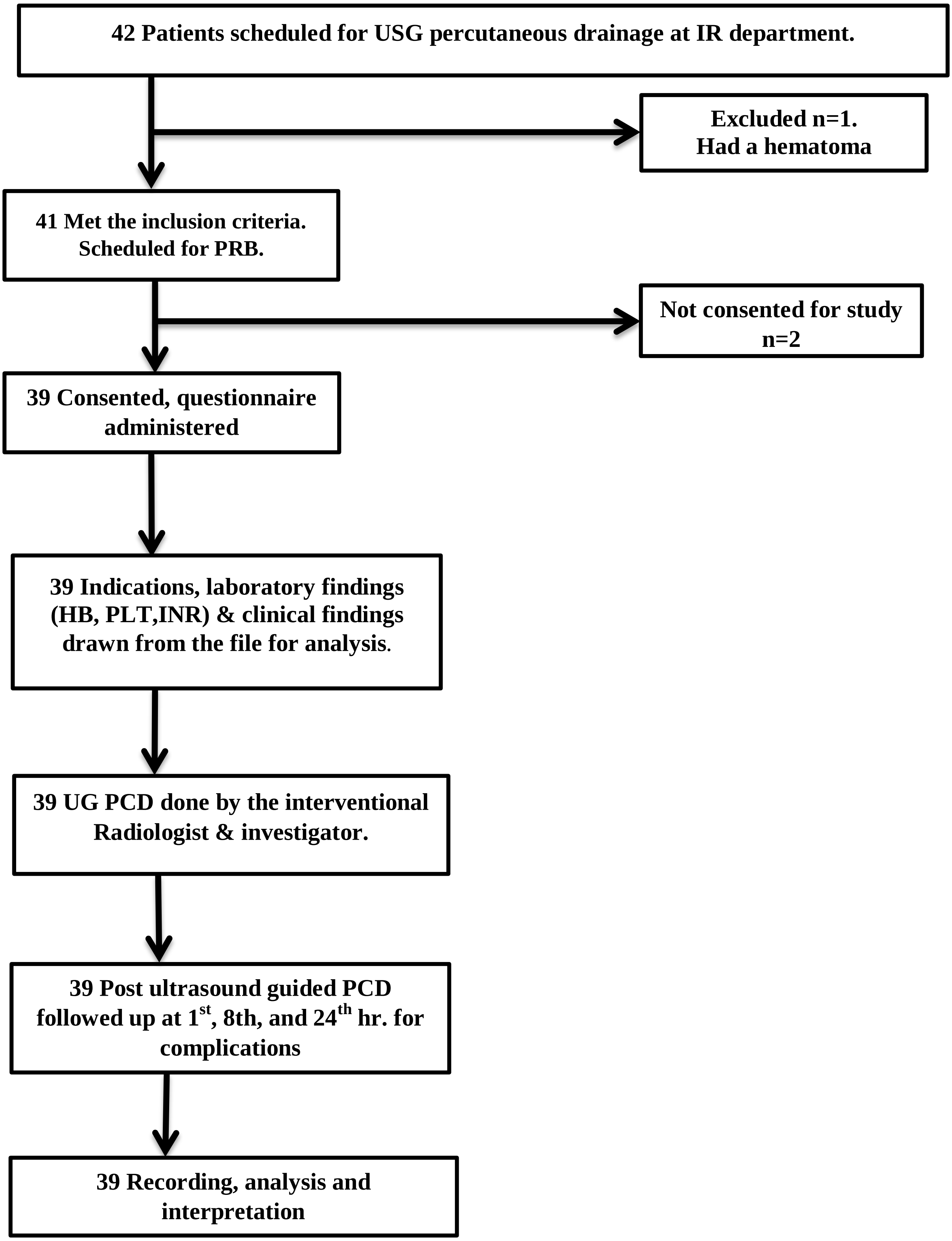
	Before PCD
Guarding	
Temperature	

SECTION E: COMPLICATIONS.

Procedural Complications	**Yes**	**After 24 Hours**	**After 72 Hours**	**After 1 week**	**No**
No Reported Complications					
Minor Complications Level A (no therapy required) & Level B (minimal therapy, includes admission for overnight observation)					
Pain					
Leaking around catheter requiring no intervention					
Fever post procedure					

Other complications (Indicate the nature of the complication) …………………………………………					
Major Complication Level C & D (resulting in hospitalization longer than overnight or increased level of care)					
Peri-catheter Leakage requiring catheter change					
Occlusion or non-functional drain					
Bleeding complications					
Pain					
Dislodged drain					
Major Complication Level E (permanent change)					
Persistent Unresolved Leaking					
Persistent unresolved fevers with sepsis					
Others((Indicate the nature of the complication) ………………………………………………					
Major Complication Level F (death)					
Arterial Bleed					
Septic Shock					
Others (Indicate the nature of the complication) ………………………………………………					

Appendix 4: Recruitment Schema



Appendix 5: IREC Approval

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471//2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2019/257
Approval Number: 0003528

30th January, 2020

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
30 JAN 2020
APPROVED
P. O. Box 4606-30100 ELDORET

Dr. Michelle Nyawira Clay,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Dr. Nyawira,

INTRA-ABDOMINAL ABSCESSES: CAUSATIVE MECHANISM, CLINICAL AND RADIOLOGICAL OUTCOMES AND COMPLICATIONS ASSOCIATED WITH PERCUTANEOUS DRAINAGE AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET

This is to inform you that ***MU/MTRH-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN:0003528.*** The approval period is ***30th January, 2020 – 29th January, 2021.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MU/MTRH-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MU/MTRH-IREC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MU/MTRH-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MU/MTRH-IREC.***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	CEO - MTRH	Dean - SOP	Dean - SOM
	Principal - CHS	Dean - SON	Dean - SOD

Appendix 6:Hospital Approval (MTRH)

An ISO 9001:2015 Certified Hospital

MOI TEACHING AND REFERRAL HOSPITAL

Telephone :(+254)053-2033471/2/3/4
Mobile: 722-201277/0722-209795/0734-600461/0734-683361
Fax: 053-2061749
Email: ceo@mtrh.go.ke/directorsofficemtrh@gmail.com

Nandi Road
P.O. Box 3 – 30100
ELDORET, KENYA

Ref: ELD/MTRH/R&P/10/2/V.2/2010

5th February, 2020

Dr. Michelle Nyawira Clay,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

APPROVAL TO CONDUCT RESEARCH AT MTRH

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:-

"Intra-Abdominal Abscesses: Causative Mechanism, Clinical and Radiological Outcomes and Complications Associated with Percutaneous Drainage at Moi Teaching and Referral Hospital, Eldoret".

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

MOI TEACHING AND REFERRAL HOSPITAL
CEO
APPROVED
05 FEB 2020
P. O. Box 3 - 30100, ELDORET

05/02/2020

DR. WILSON K. ARUASA, *MBS*
CHIEF EXECUTIVE OFFICER
MOI TEACHING AND REFERRAL HOSPITAL

cc - Senior Director, (CS)
- Director of Nursing Services (DNS)
- HOD, HRISM

All correspondence should be addressed to the Chief Executive Officer
Visit our Website: ***www.mtrh.go.ke***
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