B. Abdominal abscess

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Learning objectives

1. To understand imaging strategies and indications for drainage
2. To learn about image guidance, route planning and catheter placement
3. To appreciate the efficacy of drainage and the appropriate follow up.
Main

Abstract
Image-guided percutaneous abscess drainage is one of the most common interventional procedures performed today. It can provide definitive treatment of most collections in the chest, abdomen, pelvis and, selectively, other body parts, thus, obviating surgical exploration. The most critical step in performing percutaneous abscess drainage is selection of the imaging modality and selecting the appropriate access route to place the drainage catheter. Uncorrectable coagulopathy and lack of a safe route for catheter placement, most commonly due to interposed bowel loops, are contraindications to the procedure. Local anesthesia or light sedation is usually employed. Children and uncooperative patients may need general anesthesia. The shortest pathway between the skin entry point and the abscess is usually chosen. Tandem-trocar technique, Seldinger technique and direct trocar catheter placement are the most common catheter insertion methods. The catheter sizes used range from 8 to 24 Fr and most have an inner retention mechanism. The drainage catheter is secured to the skin after placement and the abscess is completely evacuated while the patient is in the x-ray department. The catheter is then left to gravity drainage connected to a collection bag. Occasionally, if catheter placement is not feasible, needle aspiration may be safe and effective. The catheter is checked on a daily basis and irrigated with 5-10 mL of normal saline to maintain patency. The success rate of percutaneous abscess drainage can be as high as 90% when combined with the appropriate antibiotic therapy. Major complications may include bleeding and hollow viscus perforation.

Introduction
With the developments in widely used cross-sectional imaging modalities and interventional radiology techniques, radiologists are playing an increasingly important role in the diagnosis and treatment of abscesses. Any delay in the treatment will increase morbidity and mortality, therefore, early diagnosis and intervention are critical. Mortality rates ranging from 80% to 100% in undrained abscesses have been reported and the mortality rates of surgical drainage, which was the standard treatment until 20 years ago, have ranged from 30% to 43% (1-4).

Percutaneous abscess drainage is a safe, effective, and widely used technique for the treatment of patients with abdominal or pelvic sepsis. The majority of abdominal and pelvic abscesses can be readily accessed percutaneously allowing content aspiration or placement of an imaging-guided percutaneous drainage catheter.

Imaging-guided percutaneous drainage (PD) has become the standard treatment for abdominal abscesses with low complication rates.
IMAGING GUIDANCE

CT and Ultrasonography

Detection and evaluation of abdominal fluid collections are typically accomplished with computed tomography (CT) and/or ultrasound (US) in patients who manifest signs and symptoms of possible infection or clinical impairment. The choice of treatment options for a given collection may vary among operators and depends on size, location, and clinical presentation. Therapeutic options include antibiotics coupled with supportive measures such as bowel rest and hyperalimentation, needle aspiration of the collection for drainage or to enhance antibiotic coverage, percutaneous catheter drainage (PCD), PCD with sclerotherapy, PCD with thrombolytic therapy, endoscopic drainage, immediate surgery, or delayed surgery.

The first step in most cases of imaging-guided percutaneous drainage procedures is selection of the appropriate imaging modality to guide needle/catheter placement. This varies with modality availability, operator expertise, body habitus, presence of adjacent structures and size and location of the collection.

In the majority of cases a percutaneous drainage catheter is placed under either CT or US guidance coupled with antibiotic therapy. Fluoroscopy, CT fluoroscopy or MR can be used, wherever available, however, very selectively.

In cases where abscesses or fluid collections are deep-seated, rendering percutaneous access challenging, drainage is performed under CT guidance due to superior spatial resolution compared to ultrasonography, allowing for more accurate depiction of the abscess, the adjacent organs, and allowing better planning of the access route. In addition, the use of CT reduces the likelihood of mistaking fluid-filled bowel loops for fluid collections. Although CT offers several advantages over US in guiding catheter placement for many interventional procedures, it is not always the preferred modality to use. Ultrasonography is usually chosen in cases of very superficially lying collections or abscesses. Ultrasound is a real-time modality that allows the operator to follow the course of the needles and catheters as they are advanced through tissue planes along the path to the abscess/collection. In addition, real time angulation from the axial plane, whenever required, can be performed more easily. On occasions, and when combined with US, fluoroscopy can be used to perform placement of a percutaneous drainage catheter with the Seldinger technique; i.e. after having gained access to the abscess cavity under sonographic guidance and in order to avoid loss of guide wire access or to prevent guide wire kinking during tract dilatation, fluoroscopy can be used to monitor catheter placement.

CT fluoroscopy, wherever available, can be a useful additional tool in performing challenging abscess drainages. However, care needs to be taken to reduce the radiation exposure to the patient and medical personnel while performing abscess drainage under CT fluoroscopy. Once initial CT has been performed to identify and locate the area
of interest, scanning parameters for CT fluoroscopy should be modified to reduce the radiation dose to an acceptable level (5).

PATIENT PREPARATION

All patients prior to drainage are screened for abnormal coagulation parameters (PT, aPTT, INR, CBC) and, if abnormal, corrected accordingly. If the patient is not already on antibiotics, a broad spectrum intravenous antibiotic is given one hour prior to the procedure. This will not interfere with cultures of fluid aspirates from the collection. The procedure can be done under local anesthesia, under conscious sedation or under general anesthesia in uncooperative patients and children (6).

Contraindications to percutaneous abscess drainage include uncorrectable coagulopathy and lack of a safe pathway for catheter insertion (7).

TECHNIQUE OF CATHETER INSERTION

Most procedures are performed under local anesthesia. Intravenous sedation is applied when required. General anesthesia is reserved for children and uncooperative patients. If diagnostic aspiration of the collection is considered, a 20G or 22G Chiba or Seldinger needle is used. Approximately 5 mL of fluid is aspirated. If pus is aspirated, the aspirate is sent for Gram staining. Catheter placement is followed. Drainage catheters are placed for abscesses larger than 3cm. It is always preferable to have drainage catheters of varying diameters available. After catheter placement, it is secured in place with a suture or fixation device and left to gravity drainage. The catheter is flushed with 5-10 mL of NS every 8 hours. After the procedure, rounds are made on a daily basis so that the patient status, and catheter output are followed. Reduction in the size of the abscesses and any fistulous communications are evaluated with US, CT, and an abscessogram if necessary (6, 7).

CATHETER REMOVAL

There are five criteria for catheter removal:

1. Clinical improvement, indicated by disappearance of fever and pain as well as improvement in the abnormal signs caused by the collection, such as signs of intestinal or urinary obstruction caused by the collection.

2. Improvement in abnormal laboratory test values, including return of the white blood count (WBC) and CRP to normal range, improvement in laboratory values that were abnormal because of obstruction caused by the fluid collection, and sterilization of previously positive aspirates.

3. Catheter output should return to a practically nonmeasurable amount (<10 mL per day).
4. When catheter output falls to 20-30 mL per day, catheter irrigation is discontinued.

5. If catheter output remains below 10 mL per day for more than 24 hours then the catheter can be removed unless a pancreatic, intestinal, urinary, fistula is present.

6. Absence of fistula

Fistulas close with proper drainage unless certain conditions exist, such as:

1. The system (gastrointestinal, urinary, biliary) is obstructed distally.
2. There is tumor or infection along the fistulous tract.
3. The patient has a concomitant condition impairing healing (i.e. steroids, poor nutrition)

An abscess or fluid collection may recur if the fistula has not healed by the time the drainage catheter is removed (7)

FLUID COLLECTIONS IN THE ABDOMEN AND PELVIS

Abdomen

Abdominal abscesses are usually the result of diverticulitis (8), appendicitis, Crohn's disease, and recent laparotomy. Whenever possible, open surgical drainage is avoided due to a high rate of morbidity and mortality. For small (<3 cm) collections, most authors advocate a trial of antibiotics with needle aspiration. PCD is advocated for larger collections. The highest treatment success rates with PCD have been achieved for abscesses resulting from recent laparotomy. As a result, PCD with antibiotics is usually the only treatment required.

For mature abscesses associated with appendicitis an initial combination of PCD, antibiotics, bowel rest, and, occasionally, hyperalimentation has been advocated for the same reason. On initial presentation, the vast majority of patients with appendicitis require emergent surgery. If nonoperative management is successful, 80% of patients are cured without surgery. There is a trend towards conservative treatment, including PCD, rather than acute appendectomy in patients with appendicitis complicated by abscess or phlegmon as supported by a meta-analysis of 1,572 patients in 17 studies (9).

For mature abscesses associated with Crohn's disease, an initial combination of PCD, antibiotics, high-dose steroids, bowel rest, and, occasionally, hyperalimentation has been advocated. About 50% of patients will ultimately require surgical drainage or resection, but most authors still advocate a first-line trial of PCD if technically possible (10).

Hepatic abscesses may be treated differently depending on their size and etiology. Pyogenic abscesses most often result from portal venous seeding of diverticulitis and
appendicitis, but they also may occur from obstruction of the biliary system, including the gallbladder (FIGURE 2). Pyogenic abscesses complicate 1.4% of hepatic artery embolization (HAE) procedures. Morbidity and mortality from pyogenic abscess may be increased in patients undergoing HAE who have a history of bilioenteric anastomosis or an incompetent sphincter of Oddi. For pyogenic abscesses <3 cm in diameter, authors have advocated using antibiotics, either alone or in conjunction with needle aspiration (27, 28), with excellent success rates. For pyogenic abscesses >4-5 cm in diameter, PCD is often required (11, 12). Amebic abscesses have been shown to respond extremely well to antibiotics without intervention, regardless of size, but occasionally they require needle aspiration.

**Splenic abscesses** were surgically treated until recently. However, some have advocated percutaneous catheter drainage for solitary, simple collections and splenectomy for multiple collections (13). Preservation of splenic function is maintained by the use of PCD techniques, and this should be attempted where possible and safe. Current data are relatively sparse.

**Pancreatic pseudocysts** may resolve spontaneously if they are small, stable, and sterile. Drainage is generally advocated for large (#5 cm), rapidly enlarging, painful, obstructing, or infected pseudocysts (FIGURE 3). Treatment options include endoscopic drainage with or without creation of a cystenterostomy, surgical drainage with or without creation of a cystenterostomy, and PCD. PCD generally requires a prolonged period of drainage in these patients compared to abscesses in other locations, but high rates of eventual success have been reported. Complete occlusion of the main pancreatic duct central to the pseudocyst may lead to failure of PCD and necessitate use of surgical or endoscopic marsupialization to bowel.

**Pancreatic abscesses** are associated with a high rate of mortality and are drained emergently. For poor surgical candidates, minimally invasive alternatives include endoscopic drainage or PCD which is typically used as a temporizing measure prior to surgery. High rates of clinical success have been reported using endoscopic techniques, which may be better suited for more central collections. Large, complex collections involving the tail of the pancreas or not in direct communication with the pancreas may be better treated by PCD (14-18).

**Renal abscesses** may be cured by medical treatment in over 50% of cases. Both renal and perirenal abscesses may otherwise require PCD, surgical drainage, or nephrectomy (19, 20) (FIGURE 4).

**Pelvis**

Depending on location, pelvic fluid collections can be drained via the transabdominal, transgluteal, transrectal, transvaginal, and transperineal routes. The choice of route for a given abscess varies among operators and institution type, with transrectal and transvaginal approaches used much more commonly in academic centers.
In general, reports have advocated the use of the most sterile route possible when aspirating or draining a potentially sterile collection. The transabdominal and transgluteal routes would be preferable to the endocavitary routes for a potentially sterile collection. The transperineal route is most commonly used in patients after low anterior resection for rectal cancer. The route of transgluteal drainage through the greater sciatic foramen (FIGURE 5) should be medial to the sciatic nerves and below the level of the periformis muscle to prevent the complications of persistent pain or injury to the gluteal arteries. The route and method of drainage depend on operator and patient preference as well as individual anatomic considerations (11, 12, 21).

For prostatic abscesses, the longstanding treatment method has been transurethral drainage, but needle aspiration or placement of small-bore pigtail catheters with transrectal ultrasound can reduce hospital stay (22). In selected cases, unusual abscesses, such as corpus cavernosum abscesses, percutaneous catheter drainage, may obviate the need for surgery (23).

OVERALL RESULTS AND COMPLICATIONS

The success rate of PCD combined with antibiotics and nutritional support is about 90% for simple collections and drops to 70% for infected hematomas, multilocular abscesses, abscesses complicated by bowel fistula, pancreatic abscesses and infected necrotic pancreatic collections. Drainage failures are usually due to residual undrained collections, early tube removal or inadequate position or number of catheters.

The major complications are bleeding, usually in patients with uncorrectable coagulopathy, bowel or hollow viscus injury.

If a bowel loop is traversed en route to the fluid collection, a second catheter is placed in the collection. The first catheter is withdrawn until its tip is within the bowel lumen. It is removed when a mature track forms.

If a bowel loop is erroneously drained then the catheter is left in place until a tract is formed in 10 to 15 days. The catheter is then removed safely and the track will close spontaneously.

If a catheter is erroneously placed in the urinary bladder it is removed from the bladder and a Foley catheter is placed in the bladder and removed after 7 to 10 days. (24, 25)

SUMMARY

- CT and US are the two modalities most commonly used for placement of percutaneous drainage catheters in fluid collections. US provides more detailed evaluation of complex collections, better evaluation of the solid organs, but is more limited in the evaluation of deep collections, adjacent to loops of bowel, or behind or gas containing bowel loops. CT provides better
detection of deep-seated collections, distinction from adjacent vasculature or bowel, and more thorough evaluation of patients with fever of unknown origin.

- Abdominal abscesses are usually drained with a percutaneous catheter if they are larger than 3cm and mature, and not associated with peritonitis or active hemorrhage.
- Pelvic collections may be drained using various access routes, including transabdominal, transgluteal, transperineal, and endocavitary. Sterile routes are more appropriate for potentially sterile collections.
- Refractory collections may be due to fistula formation, complex internal structure, the presence of neoplasia, or communication to the lymphatic system. Treatment options may include prolonged catheterization, upsizing catheter, diversion of upstream obstruction, bowel rest, instillation of fibrinolytic agents, instillation of sclerotherapy agents, and surgical drainage.
- PCD has been applied to splenic and pancreatic abscesses with variable results.
- Finally, thorough knowledge of the relevant anatomy, familiarity with catheter equipment and close collaboration with the referring physician are mandatory elements for success.

REFERENCES


Fig. 1: 44 year old female with a 3cm in diameter pelvic abscess treated by placement of a 12Fr pigtail catheter.

© Department of Radiology, Henry Dunant Hospital - Athens/GR
Fig. 2: 49 year old male with pyogenic hepatic abscess associated with acute cholecystitis.

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**Fig. 3:** 94 year old male with infected pancreatic pseudocysts

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Fig. 4: 65 year old male with an infected renal cyst.

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Fig. 5: 59 year old male with a pelvic abscess from diverticulitis.

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Fig. 6: 59 year old male s/p drainage catheter placement in the pelvic abscess

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References


