

ABSCESS MANAGEMENT TO INCLUDE FLUID DRAINAGE

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Fluid collections are best treated using the most minimally invasive approach possible to achieve clinical resolution. Open surgical drainage (OSD) is usually avoided due to a high rate of morbidity and mortality [1,2]. When percutaneous aspiration and percutaneous catheter drainage (PCD) is indicated, success thresholds of 95% and 85% have been recommended (3). With appropriate radiologically guided drainage of uncomplicated abscesses, morbidity and mortality rates can be significantly reduced from over 80% for untreated collections [4] to less than 5% mortality and 15% morbidity [5,6]. To achieve that end, a systematic approach following these 7 steps offers the best chance for technical and clinical success:

1. Detection and characterization of the collection
2. Choice of the most appropriate option for treatment
3. Choice of the route of access and imaging modality for drainage, if indicated
4. Drainage technique
5. Clinical follow up
6. Reimaging and treatment of complications and refractory collections
7. Catheter maintenance and removal

1. Detection and characterization of fluid collections has been revolutionized by the resolution and availability of contrast-enhanced CT and ultrasound. As a screening tool, CT provides some advantages over ultrasound in that it provides a more comprehensive evaluation of multiple systems to evaluate patients with fever of unknown origin. CT also provides better detection of deep collections, and the use of IV and oral contrast helps distinguish collections from adjacent vasculature or bowel, an advantage that has been greatly enhanced by routine coronal and sagittal reformatting. Ultrasound fails to penetrate gas, limiting its use for the evaluation of gas-containing, pulmonary, and some intraabdominal collections. The advantages of ultrasound include speed, avoidance of ionizing radiation and nephrotoxic contrast agents, excellent evaluation of the solid organs, and more detailed evaluation of the internal structure of complex collections. Ultrasound is more commonly used to screen for superficial or large fluid collections.

2. Choice of the most appropriate treatment option should not end with “to drain or not to drain.” As a clinical consult service, the Interventional Radiology service should perform a complete evaluation of the patient’s clinical status, including vital signs and laboratory parameters, and prepare a careful recommendation for treatment based on knowledge of published techniques, success and complication rates, and alternative options. Alternative options include antibiotics with supportive measures such as bowel rest and hyperalimentation, needle aspiration, PCD, PCD with sclerotherapy, and PCD with fibrinolytic therapy. In addition, referral to alternative consult services such as Surgery or Gastroenterology may be necessary as an adjunct or alternative to procedures offered by Interventional Radiology.

3. Choice of the route of access and imaging modality for drainage varies among operators and institutions based on expertise and anatomical factors such as body habitus, adjacent or overlying structures, collection size, and gas within or around the collection. In general, route of access should be the shortest possible while avoiding critical structures and cross-contamination of sterile spaces. The same advantages and disadvantages described above for collection characterization apply to the use of CT and ultrasound as guidance tools. Routes of access for pelvic fluid collections include the transabdominal, transgluteal, transrectal, transvaginal, and transperineal routes [7-11]. In general, in

order to minimize the risk of cross contamination, the most sterile route is used to aspirate or drain a potentially sterile collection. Using this rationale, 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. Conscious sedation is required for endocavitary or transgluteal pelvic drainage since patients report higher levels of discomfort compared to transabdominal drainage. The route of transgluteal drainage through the greater sciatic foramen 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. Considerations specific to anatomic location and collection type are described below.

4. Drainage techniques for PCD fall into 2 basic categories – Seldinger and trocar. Choice of technique is primarily operator dependent though trocar technique helps prevent cross-contamination of sterile spaces and loss of access during ultrasound-guided endocavitary drainage by avoiding the need for serial dilation. Catheter caliber should be sufficient to evacuate the contents of the cavity and ranges in size from 6-24 French depending on the complexity of the cavity and the nature of the material to be drained. The collection is typically drained dry using a closed system consisting of a drainage bag and a large syringe connected to the catheter using a 3-way stopcock. The catheter is then connected either to gravity drainage or negative pressure (bag or bulb), as indicated. Samples should be sent to microbiology and, if neoplasm is suspected, cytology.

Collections of the chest, abdomen and pelvis

Abdominal abscesses usually result from diverticulitis, appendicitis, Crohn's disease, and recent laparotomy and are percutaneously drained after the development of a mature wall. Peritoneal signs or active hemorrhage may indicate the need for emergent laparotomy. Small (<3 cm) collections may respond to a trial of antibiotics alone or in conjunction with needle aspiration. Abscesses associated with Crohn's disease may be treated with an initial combination of PCD, antibiotics, high dose steroids, bowel rest and hyperalimentation [12] to temporize the acute infection and improve the success rates for surgical resection under more sterile, elective conditions. Up to 50% of patients will ultimately require surgical drainage or resection [13,14]. Similarly, abscesses associated with appendicitis may be treated with an initial combination of PCD, antibiotics, bowel rest and hyperalimentation with or without subsequent ("interval") appendectomy after successful PCD [15].

Pelvic collections typically result from gastrointestinal (described above) or genitourinary infections. Many tubo-ovarian abscesses resolve with antibiotics and supportive care, but for some collections, early aspiration (for simple collections) and transvaginal drainage (for complex collections) has been advocated to prevent loss of fertility [16]. For prostatic abscesses, transrectal placement of small-bore pigtail catheters offers an alternative to transurethral drainage [17].

Pyogenic intrapulmonary abscesses usually resolve with appropriate antibiotics [18]. PCD is employed for refractory cases. Empyemas are drained by PCD if they are focal and by surgical chest tube placement if they are multiloculated and extensive. Bronchopleural fistula may require prolonged drainage with water-seal suction. Mediastinal abscesses are most commonly the result of thoracic surgical procedures and require PCD.

Collections of the solid organs

Hepatic abscesses are often amebic or pyogenic, resulting from portal venous seeding of diverticulitis or appendicitis. Small pyogenic abscesses (< 3 cm) may be successfully treated with antibiotics alone or needle aspiration [19,20] and larger pyogenic abscesses typically require PCD. Amebic abscesses often respond to antibiotics alone [21,22], but may require needle aspiration. Splenic abscesses, when uncomplicated and single, may respond to aspiration or PCD [23,24]. Pancreatic pseudocysts are treated when they are large (5 cm or greater), rapidly enlarging, painful, obstructing, or infected. Treatment options include endoscopic or surgical drainage with or without marsupialization to bowel. When PCD is considered, patients should be warned of a potentially prolonged period of drainage compared to abscesses in other locations. Pancreatic abscesses require emergent drainage; PCD is usually employed for collections in the pancreatic tail, and surgery is often ultimately necessary due to cure rates typically below 30% [25-28]. Endoscopic drainage is optimal for more central collections and those abutting the

greater curvature of the stomach. Renal abscesses may be cured by medical treatment in over 50% of cases, but may require drainage if complex, large or refractory.

5. Clinical follow-up should be performed by a dedicated member of the Interventional Radiology service daily for inpatients and during pre-arranged visits to IR clinic for outpatients. Catheters may be irrigated with 5 cc of sterile saline every shift after 1-2 days, but earlier irrigation with larger volumes may lead to systemic spread of infection. Particularly viscous or complex collections may require more frequent or larger volume irrigation. Hyperplastic skin tags adjacent to the catheter can be treated with silver nitrate sticks. Pericatheter cellulitis may require antibiotics. Catheter obstruction may require irrigation, catheter exchange or catheter upsizing. Patient assessment, focused physical exam, vital signs, drainage output, and pertinent laboratory parameters should be discussed in the chart note, and assessment and plan may indicate the need for reimaging or catheter removal, as discussed below.

6. Reimaging and treatment of complications and refractory collections may be necessary based on findings during routine follow-up. Persistent signs and symptoms of infection may require reimaging to assess for refractory or new collections and plan follow-up treatment. Collections may persist or worsen due to fibrous septations, fistulas, and neoplastic tissue. Potential treatment options include catheter upsizing or surgical drainage. Sterile cysts, lymphoceles and seromas may resolve after intracavitary instillation of sclerotherapy agents such as ethanol or tetradecyl sulfate [29]. Persistent or increasing catheter output may require abscessogram under fluoroscopy to rule out fistulization to adjacent fluid-producing structures. Fistulas to enteric, biliary, genitourinary, pancreatic or bronchial systems often require prolonged drainage for clinical success [30-33].

Fibrinolysis of complex collections may be performed by intracavitary instillation of agents such as tissue plasminogen activator [33,34] with high rates of success demonstrated for abdominal and pelvic abscesses, organizing hemothorax and empyema, and low rates of bleeding complications, except for a 33% rate of pleural hemorrhage noted using intrapleural r-t-PA for patients on anticoagulation [34]. Most physicians adhere to the same contraindications considered for intravascular use of rt-PA. Typically, rt-PA mixed with normal saline is injected into the drainage catheter; the catheter is capped or placed to water seal for 4-6 hours, and then replaced to suction drainage.

If PCD fails to resolve the associated fluid collection despite these measures, the benefit of PCD may be to limit the hematogenous or local spread of infection and improve the acute clinical presentation, thereby preparing the patient for a more elective, single-step surgical procedure.

7. Catheter maintenance and removal usually involves routine catheter changes every 4 to 6 weeks and catheter removal when drainage gradually decreases to less than 20 cc per day. Sudden cessation of output or the development of pericatheter leakage usually indicates catheter obstruction, and exchange or upsizing should be considered. Persistent high levels of output may signal fistula formation and the need for an abscessogram under fluoroscopy. After PCD, persistent fevers beyond 48 hours and persistent leukocytosis beyond 5 days may indicate a refractory collection, and follow-up imaging is indicated.

REFERENCES

1. Olak J, Christou NV, Stein LA, Casola G, Meakins JL. Operative vs. percutaneous drainage of intra-abdominal abscesses: comparison of morbidity and mortality. *Arch Surg* 1986; 121(2):141-6.
2. vanSonnenberg E, Ferrucci JJ, Mueller P, Wittenberg J, Simeone J. Percutaneous drainage of abscesses and fluid collections: techniques, results and applications. *Radiology* 1982;151:337-41.
3. Bakal CW, Sacks D, Burke DR, et al. Quality improvement guidelines for adult percutaneous abscess and fluid drainage. *JVIR* 1994; 6:68-70.
4. Altemeier W, Culbertson W, Fiullen W, Shook C. Intraabdominal abscesses. *Am J Surg* 1973;125:70-9.
5. vanSonnenberg E, Mueller PR, Ferrucci JT. Percutaneous drainage of 250 abdominal abscesses and fluid collections. Part I; results failures and complications. *Radiology* 1984; 151(2):337-41.
6. Mueller P, vanSonnenberg E, Ferrucci JJ. Percutaneous drainage of 250 abdominal abscesses and fluid collections. 2. Current procedural concepts. *Radiology* 1984;151:343-7.
7. Nelson AL, Sinow RM, Oliak D. Transrectal ultrasonographically guided drainage of gynecologic pelvic abscesses. *Am J Obstet Gynecol.* 2000;182(6):1382-8.
8. Harisinghani MG, Gervais DA, Maher MM et al. Transgluteal approach for percutaneous drainage of deep pelvic abscesses: 154 cases. *Radiology* 2004;233(1):300-1.
9. Cahill AM, Baskin KM, Kaye RD, Fitz CR, Towbin RB. Transgluteal approach for draining pelvic fluid collections in pediatric patients. *Radiology* 2005;234(3):893-8.
10. Lee BC, Mcgahan JF, Bijan B. Single-step transvaginal aspiration and drainage for suspected pelvic abscesses refractory to antibiotic therapy. *J Ultrasound Med* 2002;21(7):731-8.
11. Sperling DC, Needleman L, Eschelmann DJ, Hovsepian DM, Lev-Toaff AS. Deep pelvic abscesses: Transperineal US-guided drainage. *Radiology* 1998;208(1):111-5.
12. Poritz LS, Koltun WA. Percutaneous drainage and ileocelectomy for spontaneous intraabdominal abscess in Crohn's disease. *J Gastrointest Surg* 2007;11(2):204-8.
13. Gutierrez A, Lee H, Sands BE. Outcome of surgical versus percutaneous drainage of abdominal and pelvic abscesses in Crohn's disease. *Am J Gastroenterol* 2006; 101(10):2283-9.
14. Gervais DA, Hahn PF, O'Neill MJ, Mueller PR. Percutaneous abscess drainage in Crohn disease: technical success and short- and long-term outcomes during 14 years. *Radiology.* 2002; 222(3):645-51.
15. Kaminski A, Liu IL, Applebaum H, Lee SL, Haigh PI. Routine interval appendectomy is not justified after initial nonoperative treatment of acute appendicitis. *Arch Surg* 2005; 140(9):897-901.
16. Fabiszewski NL, Sumkin JH, Johns CM. Contemporary radiologic percutaneous abscess drainage in the pelvis. *Clin Obstet Gynecol* 1993; 36(2):445-56.
17. Chou YH, Tiu CM, Chen JD, et al. Prostatic abscess: transrectal color Doppler ultrasonic diagnosis and minimally invasive therapeutic management. *Ultrasound Med Bio* 2004;30(6):719-24

18. Moreira Jda S, Camargo Jde J, Felicetti JC, Goldenfun PR, Moreira AL, Porto Nda S. Lung abscess: analysis of 252 consecutive cases diagnosed between 1968 and 2004. *J Bras Pneumol*. 2006; 32(2):136-43.
19. Stain SL, Yellin AE, Donovan AJ, Brien HW. Pyogenic liver abscess: modern treatment. *Arch Surg* 1991; 126(8):991-6.
20. Qin SL, Wang AX, Sheng RY, Liu ZY. [Clinical analysis of 36 cases with amebic liver abscess]. *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi*. 2000;18(6):356-8.
21. Pitt HA. Surgical management of hepatic abscess. *World J Surg* 1990; 14(4):498-504
22. Donovan AJ, Yellin AE, Ralls PW. Hepatic abscess. *World J Surg* 1991;15(2):162-9.
23. Tung CC, Chen FC, Lo CJ. Splenic abscess: an easily overlooked disease? *Am Surg*. 2006;72(4):322-5.
24. Chang KC, Chuah SK, Changchien CS. Clinical characteristics and prognostic factors of splenic abscess: a review of 67 cases in a single medical center of Taiwan. *World J Gastroenterol*. 2006 Jan 21;12(3):460-4.
25. Rotman N, Mathieu D, Anglade MC, Fagniez PL. Failure of percutaneous drainage of pancreatic abscesses complicating severe acute pancreatitis. *Surg Gynecol Obstet* 1992; 174(2):141-4.
26. Steiner E, Mueller PR, Hahn PF, et al. Complicated pancreatic abscesses: problems in interventional management. *Radiology* 1988; 167(2):443-6.
27. Mithofer K, Mueller PR, Warshaw AL. Interventional and surgical treatment of pancreatic abscess. *World J Surg* 1997; 21(2):162-8.
28. Bradley EL, Olson RA. Current management of pancreatic abscess. *Adv Surg* 1991; 24:361-88.
29. Demir E, Alan C, Kilciler M, Bedir S. Comparison of ethanol and sodium tetradecyl sulfate in the sclerotherapy of renal cyst. *J Endourol* 2007;21(8):903-5.
30. Wittich G. Radiologic treatment of abdominal abscesses with fistulous communications. *Curr Opin Radiol* 1992; 4(4):110-5.
31. Schuster MR, Crummy AB, Wojtowycz MM, McDermott JC. Abdominal abscesses associated with enteric fistulas: percutaneous management. *J Vasc Interv Radiol* 1992; 3(2):359-63.
32. Do H, Lambiase RE, Deyoe L, Cronan JJ, Dorfman GS. Percutaneous drainage of hepatic abscesses: comparison of results in abscesses with and without intrahepatic biliary communication. *AJR* 1991; 157(6):1209-12.
33. Beland MD, Gervais DA, Levis DA, Hahn PF, Arellano RS, Mueller PR. Complex abdominal and pelvic abscesses: efficacy of adjunctive tissue-type plasminogen activator for drainage. *Radiology* 2008;247(2):567-73.
34. Gervais DA, Levis DA, Hahn PF, Uppot RN, Arellano RS, Mueller PR. Adjunctive intrapleural tissue plasminogen activator administered via chest tubes placed with imaging guidance: effectiveness and risk for hemorrhage. *Radiology* 2008;246(3):956-63.