

**American College of Radiology  
ACR Appropriateness Criteria®**

**Clinical Condition:** Radiologic Management of Infected Fluid Collections

**Variant 1:** Patient with right lower quadrant abdominal pain, fever, and leukocytosis for 7 days. Physical examination shows no peritoneal signs. CT scan shows a thin-walled, 3 × 4 cm fluid collection adjacent to the cecum, nonvisualization of the appendix, and an appendicolith. Imaging findings are highly suspicious for appendicitis. Treatment includes antibiotics.

Treatment/Procedure	Rating	Comments
Percutaneous catheter drainage (PCD) only	7	
PCD followed by delayed surgery	6	
Needle aspiration	4	Consider this procedure if there is no response to antibiotics.
Conservative management only	3	
Immediate surgical drainage	2	
<b><u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>		

**Variant 2:** Patient with a history of left hemicolectomy 2 months ago for colon carcinoma. The patient presents with abdominal pain and fever 2 weeks after placement of a 12-French drain into a complex, 5 cm abdominal fluid collection. Catheter output is 25 cc per day, and the collection is unchanged in size by CT. No fistula. Complex purulent collection. Treatment includes antibiotics.

Treatment/Procedure	Rating	Comments
Catheter upsizing	7	Use of this procedure depends on viscosity of fluid.
Intracavitary thrombolytic therapy and drainage	6	This procedure is commonly used, but evidence is lacking.
Laparoscopic drainage	5	Consider this procedure when clinical response to second-line therapy PCD is incomplete.
Open surgical drainage	5	Consider this procedure when clinical response to second-line therapy PCD is incomplete.
Continued antibiotics and drainage	3	
Continued antibiotics and drain removal	1	
<b><u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>		

**Clinical Condition:** Radiologic Management of Infected Fluid Collections

**Variant 3:** Patient who is an IV drug abuser presents with fever and tachycardia and on imaging is found to have 2 noncommunicating splenic abscesses measuring 4 cm in diameter, accessible percutaneously through a 1 cm rim of normal splenic tissue. Appropriate management includes antibiotics.

Treatment/Procedure	Rating	Comments
Percutaneous catheter drainage (PCD) only	7	This procedure is considered second-line therapy.
Splenectomy	6	Consider this procedure if PCD fails or is complicated.
Needle aspiration	5	Consider this procedure to aspirate and hone antibiotic therapy if surgical risk is too high.
Conservative management only	3	
<b><u>Rating Scale:</u></b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

**Variant 4:** Patient with abdominal pain radiating to the back 5 weeks after hospitalization for acute pancreatitis. Afebrile. CT scan shows a 5 cm walled-off collection in the body of the pancreas indenting a broad portion of the body of the stomach. The collection is percutaneously accessible with a 3 cm window. MRCP shows a patent pancreatic duct.

Treatment/Procedure	Rating	Comments
Endoscopic cystgastrostomy	8	Use of this procedure depends on the availability of a skilled endoscopist.
Percutaneous catheter drainage (PCD) only	6	
Surgical cystenterostomy	5	
Conservative management only	3	
Percutaneous needle aspiration	3	Consider this procedure as a diagnostic tool to demonstrate that the symptoms are related to the pseudocyst.
<b><u>Rating Scale:</u></b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

**Variant 5:** Patient with a 2-week history of cough, fever, and foul-smelling sputum. Worsening despite a full course of broad-spectrum antibiotics. Sputum cultures negative. CT scan shows a 4 cm fluid collection in the lower lobe of the right lung.

Treatment/Procedure	Rating	Comments
Percutaneous catheter drainage (PCD) only	7	
Surgery	4	Consider this procedure if drainage fails.
Another course of antibiotics and postural drainage	3	
Needle aspiration	3	This procedure may help target antibiotic therapy but should not be used as a primary therapy.
<b><u>Rating Scale:</u></b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

**Clinical Condition:** Radiologic Management of Infected Fluid Collections

**Variant 6:** Woman of childbearing age with abdominal pain, fever, and leukocytosis. Marked tenderness on pelvic examination. CT scan shows a 4 cm walled-off probable tubo-ovarian abscess (TOA), safely accessible from the transgluteal, transvaginal, and transrectal approaches. Appropriate first-line treatment includes antibiotics.

Treatment/Procedure	Rating	Comments
Transvaginal PCD	7	Transvaginal versus transgluteal approach should be determined on a case-by-case basis and depends on expertise and patient preference.
Transgluteal PCD	7	Transvaginal versus transgluteal approach should be determined on a case-by-case basis and depends on expertise and patient preference.
Transvaginal needle aspiration	6	Transvaginal versus transgluteal approach should be determined on a case-by-case basis and depends on expertise and patient preference.
Transgluteal needle aspiration	6	Transvaginal versus transgluteal approach should be determined on a case-by-case basis and depends on expertise and patient preference.
Conservative management only	5	TOAs may resolve with antibiotics, but they are often treated more aggressively in young patients to preserve fertility. Some will resolve with conservative management and antibiotics. The literature is unclear.
Surgical/laparoscopic drainage	4	Consider this procedure when drainage routes or other techniques are difficult or have failed.
Transrectal needle aspiration	3	This procedure could lead to superinfection. Consider it only if other approaches are not reasonable.
Transrectal PCD	3	
Endoscopic US-guided drainage	3	Consider this procedure as an alternative to imaging-guided techniques for failed or difficult-to-reach cases.
<b><u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>		

# RADIOLOGIC MANAGEMENT OF INFECTED FLUID COLLECTIONS

Expert Panel on Interventional Radiology: Jonathan M. Lorenz, MD<sup>1</sup>; Waddah B. Al-Refaie, MD<sup>2</sup>; Brooks D. Cash, MD<sup>3</sup>; Ron C. Gaba, MD<sup>4</sup>; Debra A. Gervais, MD<sup>5</sup>; Matthew G. Gipson, MD<sup>6</sup>; Kenneth J. Kolbeck, MD, PhD<sup>7</sup>; Brian E. Kouri, MD<sup>8</sup>; Francis E. Marshalleck, MBBS<sup>9</sup>; Ajit V. Nair, MD<sup>10</sup>; Charles E. Ray, Jr, MD, PhD<sup>11</sup>; Eric J. Hohenwarter, MD.<sup>12</sup>

## **Summary of Literature Review**

### **Introduction/Background**

Radiologic management of clinically significant fluid collections has largely replaced open surgical drainage (OSD) as a first-line therapeutic consideration in conjunction with supportive medical management. Recent studies support the results of retrospective, peer-reviewed studies published since the 1980s demonstrating favorable clinical success rates and low complication rates for radiologic drainage. However, physiologic and anatomic factors may render radiologic management less optimal compared to alternative therapies, including OSD. Such factors include collections without a safe percutaneous approach, collections refractory to radiologic management, and collections with a more favorable endoscopic drainage option. In the past decade, endoscopic, laparoscopic, and multidisciplinary approaches have been described, and those approaches should be considered, when applicable, to reduce procedure risk, improve clinical success, avoid external catheter placement, and improve patient comfort.

### **Overview of Diagnostic Imaging Options**

Detection and evaluation of 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. Routine imaging of postoperative patients should be discouraged, as postoperative fluid collections are commonly present and may not be infected. Expense and availability limit magnetic resonance imaging (MRI) for this purpose. US is fast, avoids ionizing radiation, and provides more detailed evaluation of the internal structure and composition of complex collections. US is more limited in the evaluation of collections deep within the soft-tissues or adjacent to loops of bowel than CT or MRI, and it fails to penetrate intracavitary, pulmonary, or enteric gas. Therefore, US is more commonly used to screen for superficial or large fluid collections and collections within or adjacent to solid organs. CT provides the advantage of detecting deep collections, and the use of intravenous (IV) and oral contrast can help distinguish collections from adjacent vasculature or bowel. CT is usually the first-line modality in patients with fever of unknown origin. Multidetector CT scanners with sagittal and coronal reformatting can help distinguish collections from adjacent structures.

### **Overview of Therapeutic Options**

The choice of imaging guidance for draining fluid collections varies with availability, operator expertise, body habitus, presence of adjacent structures, size and location of the collection, and presence of intracavitary or enteric gas. The choice of treatment options for a given collection may vary among operators and depends on size, location, and clinical presentation. Options include antibiotics coupled with supportive measures such as bowel rest and hyperalimentation, needle aspiration for drainage or to hone antibiotic coverage, percutaneous catheter drainage (PCD), PCD with sclerotherapy, PCD with thrombolytic therapy, endoscopic drainage, immediate surgery, or delayed surgery.

Two basic techniques are available for PCD: Seldinger and trocar. For percutaneous aspiration and drainage, success thresholds of 95% and 85% have been recommended [1]. Choice of technique is primarily operator dependent, though the trocar technique has been advocated for endocavitary drain placement to avoid the risk of loss of access during the process of serial dilation—a complication associated with the Seldinger technique. Although a safe window to the collection is required for drainage, techniques such as hydrodissection [2] and

<sup>1</sup>Principal Author, University of Chicago Hospital, Chicago, Illinois. <sup>2</sup>Georgetown University Hospital, Washington, District of Columbia, American College of Surgeons. <sup>3</sup>University of South Alabama, Mobile, Alabama, American Gastroenterological Association. <sup>4</sup>University of Illinois Hospital, Chicago, Illinois. <sup>5</sup>Massachusetts General Hospital, Boston, Massachusetts. <sup>6</sup>University of Colorado, Anschutz Medical Campus, Aurora, Colorado. <sup>7</sup>Oregon Health and Science University, Portland, Oregon. <sup>8</sup>Wake Forest University Baptist Medical Center, Winston-Salem, North Carolina. <sup>9</sup>Riley Hospital for Children, Indianapolis, Indiana. <sup>10</sup>Santa Clara Valley Medical Center, San Jose, California. <sup>11</sup>Specialty Chair, University of Colorado, Anschutz Medical Campus, Aurora, Colorado. <sup>12</sup>Panel Chair, Froedtert & The Medical College of Wisconsin, Milwaukee, Wisconsin.

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alternative approaches such as transhepatic drainage of abdominal collections [3,4] have been described to improve technical success rates.

## **Discussion by Variant**

### *Variant 1: Abdominal Collections*

Abdominal abscesses are most often the result of diverticulitis, appendicitis, Crohn disease, and recent laparotomy. When possible, OSD is avoided due to a high rate of morbidity and mortality [5,6]. For the management of small (<3 cm) collections, most authors advocate a trial of antibiotics alone with consideration given to needle aspiration to hone antibiotic coverage for persistent cases [7,8]. This approach uses follow-up imaging and repeat aspiration if the collection does not resolve. PCD is advocated for larger collections. Peritoneal signs, active hemorrhage, and lack of maturation of the abscess wall have been suggested as contraindications to PCD [9]. The highest success rates have been achieved for abscesses resulting from recent laparotomy [10-12] and, as a result, PCD with antibiotics is usually the only treatment required for this entity. For diverticular abscesses, a retrospective review of 218 patients showed that PCD with antibiotics obviated the need for subsequent colectomy in 85% of cases [13].

For mature abscesses associated with Crohn disease, an initial combination of PCD, antibiotics, high-dose steroids, bowel rest, and (on occasion) hyperalimentation has been advocated [14] to reduce the failure rate of PCD, temper the acute infection, and allow for surgical resection under more sterile, elective conditions. When surgery is required, preliminary PCD has been shown to reduce postdrainage complications and the ultimate need for stomal creation [15]. Some patients (33%–50%) will ultimately require surgical drainage or resection [16,17], but most authors still advocate a first-line trial of PCD if technically possible. In a study of 25 patients with Crohn disease, PCD performed an average of 37 days before surgery significantly reduced the rate of severe, postoperative septic complications such as anastomotic leak, intra-abdominal abscess, and fistula [18]. Published studies on the benefit of initial PCD to reduce the rate of postoperative septic complications demonstrate conflicting results, and the benefit of PCD for this purpose remains unclear [18,19].

For mature abscesses associated with appendicitis, an initial combination of PCD, antibiotics, bowel rest, and (on occasion) hyperalimentation has been advocated for the same reason. In a retrospective review of 80 cases, nonoperative management was associated with a significantly lower rate of complications and a significantly shorter hospital stay compared to operative management [20]. Some disagreement exists in the literature regarding the need for subsequent (“interval”) appendectomy after successful PCD [21]. In a study of 1,012 patients with appendicitis, Kaminski et al [21] evaluated the need for PCD and the subsequent need for interval appendectomy after successful PCD. On initial presentation, the vast majority of patients with appendicitis underwent emergent surgery, although a strategy of avoidance of open surgery in both simple and complicated cases of appendicitis continues to evolve since this publication. If nonoperative management was successful, 80% of patients were cured without surgery. The push for conservative management, including PCD, rather than acute appendectomy for patients with appendicitis complicated by abscess or phlegmon is supported by a meta-analysis of 1,572 patients in 17 studies showing significant reductions in complication rates [22].

### *Variant 2: Complex/Refractory Collections*

Persistence of fluid collections despite PCD may be the result of factors such as complex loculations and septations; fistulization of the cavity to the enteric, biliary, genitourinary, pancreatic, or bronchial systems; the presence of neoplastic tissue; and communication of the cavity to the lymphatic system. Depending on the reason for incomplete drainage, options may include catheter manipulation, catheter upsizing, diversion of upstream obstructions, or surgical drainage—both open and laparoscopic. In a retrospective study of 82 abscesses that were refractory to PCD and clinical management, catheter exchange resulted in clinical success without surgery in 76.8% [23]. Enteric or biliary fistulas have been treated with a variety of therapies with varied success, though a recent series of 11 cases treated with N-butyl cyanoacrylate glue within the cavity and fistula tract resulted in 100% clinical success [24]. Fibrinolysis of complex, multiseptated fluid collections refractory to PCD by intracavitary instillation of fibrinolytic agents such as tissue plasminogen activator has been reported [25,26].

Available reports are limited in number, and often small but high rates of clinical success have been demonstrated retrospectively for abdominal and pelvic abscesses [25] as well as organizing hemothorax and empyema [26]. Case reports have even demonstrated success in the fibrinolytic treatment of refractory, complex splenic abscesses [27]. In a prospective study of 100 patients with abdominal abscesses randomized to regular instillation of sterile saline versus urokinase during catheter drainage, the urokinase group had no increase in complication rate but

showed a reduction in hospital stay, drainage duration, and overall cost of treatment [28]. In a similar, though smaller prospective, randomized study of 20 patients with complicated intra-abdominal abscesses, patients receiving intracavitary alteplase showed a 72% clinical success rate compared to 22% for patients receiving sterile saline [29]. Rates of bleeding complications using intracavitary recombinant tissue plasminogen activator (r-tPA) have been low to zero for pelvic, abdominal, and chest collections, except for a 33% rate of pleural hemorrhage noted for intrapleural r-tPA for patients on anticoagulation [26].

For persistent sterile collections such as cysts, lymphoceles, and seromas, a number of reports describe high rates of success in shortening the period of catheterization by intracavitary instillation of sclerotherapy agents such as ethanol or tetradecyl sulfate [30]. For cases of fistulization of the abscess cavity to enteric, biliary, genitourinary, pancreatic, or bronchial systems, PCD may be successful with prolonged catheterization [31,32].

PCD of an infected or fluid-filled tumor may be inadvertent or intentional. For good surgical candidates, tumor resection is typically performed. For poor surgical candidates, the period of catheterization may be markedly prolonged or indefinite [33]. Despite this finding, patients with infected, inoperable tumors at risk for systemic infection may opt for PCD.

On occasion, PCD fails to resolve the associated fluid collection despite these measures. In such circumstances, 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. This treatment algorithm has been described for appendicitis and Crohn disease [16].

#### *Variant 3: Splenic and Hepatic Collections*

Splenic abscesses were considered to be surgical cases as recently as the 1990s, but a number of small, retrospective series [34,35] have readdressed this issue, some advocating the benefits of PCD for solitary, simple collections and splenectomy for multiple collections. In a retrospective study of 18 children with splenic abscesses, IV antibiotics were administered to all patients, and 10 underwent PCD for the inclusionary threshold of an abscess diameter >3 cm. Clinical response was 100% [36]. 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, and treatment choices, even within a single institution, are often variable [37].

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. Pyogenic abscesses complicate 1.4% of hepatic artery embolization (HAE) procedures [38]. 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. Mortality is also high for abscesses associated with malignancy, though PCD is clinically successful in approximately two-thirds of such cases [39]. For pyogenic abscesses <3 cm in diameter, authors have advocated using antibiotics, either alone or in conjunction with needle aspiration [40,41], with excellent success rates. For pyogenic abscesses >4–5 cm in diameter, PCD is often required. Clinical success may be influenced by the infecting organism. Amebic abscesses have been shown to respond extremely well to antibiotics without intervention, regardless of size, but occasionally they require needle aspiration [40].

#### *Variant 4: Retroperitoneal Collections*

A significant amount of confusing terminology is used when discussing pancreatitis, including acute and subacute fluid collections. Operators are urged to adhere to standards such as the Atlanta classification when describing such collections [42]. Pancreatic pseudocysts may resolve spontaneously if they are small, stable, and sterile. Drainage is generally advocated for large ( $\geq 5$  cm), rapidly enlarging, painful, obstructing, or infected pseudocysts. Techniques for drainage are multidisciplinary [43,44], and continued disagreement of the optimal use of these techniques leads to a variety of treatment algorithms for these patients. 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 [44]. 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 suboptimal surgical candidates, minimally invasive alternatives include endoscopic drainage or PCD [44-47]. PCD is

typically used as a temporizing measure prior to surgery, since cure rates range from 14% to 32% [45,47,48]. High rates of clinical success have been reported using endoscopic techniques [46,49], which may be optimal for more central collections and those abutting the greater curvature of the stomach. Large, complex collections involving the tail of the pancreas or those collections not in direct communication with the pancreas may be better treated by PCD.

Renal abscesses may be cured by medical treatment in over half of cases [50], even up to 64% [51], and both renal and perirenal abscesses may otherwise require PCD, surgical drainage, or nephrectomy.

#### *Variant 5: Chest Collections*

Parenchymal lung abscesses most often occur from aspiration of anaerobic oropharyngeal bacteria or from fungal organisms. Alcoholics, immunocompromised patients, and patients with bronchial obstruction are predisposed. The organism is usually determined by culture of sputum or blood and, less optimally, by culture of cavitary fluid obtained by needle aspiration or bronchoscopy. The majority (typically >80%) is treated to resolution with antibiotics and conservative management [52]. PCD and surgical resection/drainage are generally reserved for cases that persist or worsen despite antibiotics [53,54]. In a retrospective study of 40 patients with lung abscesses refractory to antibiotic therapy, complete resolution was achieved with PCD in 83%, and the remainder required surgery [55]. Empyemas are typically drained by PCD if they are focal or uniloculated, and by surgical chest tube placement if they are multiple, multiloculated, complex, and extensive. Persistent, complex collections and organizing hemothoraces have been successfully treated with instillation of fibrinolytic agents [26]. Communication to the bronchial tree in the form of a bronchopleural fistula may require prolonged catheter drainage with the catheter placed to suction water seal.

Persistent, large, malignant, and benign pleural effusions have been successfully treated or managed with pleurodesis through small-bore catheters [56] or permanent drainage catheters with one-way valves to prevent pneumothorax [57].

Mediastinal abscesses are most commonly the result of thoracic surgical procedures and usually require PCD. Though these cases may be technically challenging, limited studies show low complication rates, technical success approaching or reaching 100%, and clinical success exceeding 90% without the need for surgery [58].

#### *Variant 6: Pelvic Collections*

Depending on location, pelvic fluid collections can be drained via the transabdominal, transgluteal, transrectal, transvaginal, and transperineal routes. The efficacy and safety of these routes have been established by a number of retrospective reports [59-63]. 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 [64]. In general, reports have advocated the use of the most sterile route possible when aspirating or draining 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 [63]. Some disagreement exists in the literature regarding the level and incidence of significant or persistent pain when comparing the transgluteal and endocavitary routes. At a minimum, conscious sedation is required for these procedures. The route of transgluteal drainage through the greater sciatic foramen should be medial to the sciatic nerves and below the level of the piriformis muscle to prevent the complications of persistent pain [60] or injury to the gluteal arteries. When collections are inaccessible by all of these techniques, open surgical intervention may be avoided in some cases by endoscopic US-guided transrectal or transcolonic drainage without fluoroscopy [65] or by laparoscopic drainage [66].

For tubo-ovarian abscesses (TOAs), some disagreement exists in the literature regarding the appropriate treatment. In a retrospective study of 122 patients, nearly two-thirds resolved with antibiotics and supportive care [67]. However, early aspiration (for simple collections) and drainage (for complex collections) have been advocated to prevent prolongation of the disease and the potential associated loss of fertility. Salpingo-oophorectomy and OSD may become necessary in refractory cases and may be more commonly required for TOAs of gastrointestinal rather than gynecological origin [68]. For women of reproductive age desiring pregnancy, if TOA exists without intra-abdominal rupture, medical management and early drainage results in pregnancy rates of 32%–63% compared to 4%–15% with medical management alone [69,70]. The route and method of drainage depend on operator and patient preference as well as individual anatomic considerations.

For prostatic abscesses, the longstanding treatment method has been transurethral drainage, but recent small studies have demonstrated that guidance of needle aspiration or placement of small-bore pigtail catheters using transrectal US can shorten hospital stay [71] and provide a viable alternative.

### Summary of Recommendations

- CT and US are the most common modalities used to diagnose and guide PCD of fluid collections. US provides more detailed evaluation of complex collections and excellent evaluation of the solid organs but is more limited in the evaluation of collections deep within the soft tissues, adjacent to loops of bowel, or behind or containing gas. CT provides better detection of deep collections, distinction from adjacent vasculature or bowel, and more complete evaluation of patients with fever of unknown origin.
- Abdominal abscesses are typically drained with PCD if they are large (>4–5 cm), mature, and not associated with peritonitis or active hemorrhage. Imaging immediately after drainage will allow determination if additional catheters are necessary, as all collections should be preferably drained at the initial setting unless lack of a safe pathway precludes such an approach.
- Pelvic collections may be drained using multiple routes of access, including transabdominal, transgluteal, transperineal, and endocavitary. Sterile routes are more appropriate for potentially sterile collections.
- Collections may be refractory to PCD in cases of fistula formation, complex internal structure, the presence of neoplastic tissue, or communication to the lymphatic system. Depending on the cause, treatment options include prolonged catheterization, catheter manipulation or upsizing, 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 and recommendations in the literature, suggesting that the best current approach is multidisciplinary, depending on the extent and location of disease.
- Smaller abscesses and abscesses of the kidney and lung parenchyma have a high rate of clinical response to antibiotic therapy and supportive care, with more invasive treatments typically reserved for extensive or refractory cases.

### Summary of Evidence

Of the 71 references cited in the *ACR Appropriateness Criteria® Radiologic Management of Infected Fluid Collections* document, 65 are categorized as therapeutic references including 2 well-designed studies, 25 good quality studies, and 11 quality studies that may have design limitations. Additionally, 6 references are categorized as diagnostic references including 2 quality studies that may have design limitations. There are 28 references that may not be useful as primary evidence.

The 71 references cited in the *ACR Appropriateness Criteria® Radiologic Management of Infected Fluid Collections* document were published between 1984–2013.

While there are references that report on studies with design limitations, 30 well designed or good quality studies provide good evidence.

### Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to [www.acr.org/ac](http://www.acr.org/ac).

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.