# Radiographically Guided Percutaneous Catheter Drainage of Pleural Fluid Collections

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**We reviewed the outcome of guided percutaneous catheter drainage of pleural fluid collections in 18 patients over a 5-year period. Catheter positioning was guided by fluoroscopy in 10 (56%) cases, CT in seven (39%), and sonography in one (6%). Included were 16 patients with empyemas and one each with a sterile hematoma and transudate. In nine of the patients, previous surgical chest tube drainage had been unsuccessful. The majority of collections were treated with a 12- or 14-French catheter and closed underwater seal drainage. Twelve (80%) of the 15 patients who had an adequate trial of guided drainage were cured. Propyliodone oil suspension contrast sinography after catheter placement showed two clinically unsuspected bronchopleural fistulas. Although an extensive multilocular pleural collection was a contraindication to percutaneous catheter drainage, the thick fibrous peel of a chronic empyema was not.**

**Drainage of pleural fluid collections with radiographic guidance ensures proper catheter placement and is successful in a high percentage of cases.**

Pleural fluid collections may pose a difficult therapeutic problem. Mortality rates up to 46% have been reported with empyemas in the elderly or immunosuppressed [1]. Adequate external drainage is the mainstay of therapy. Therapeutic options include thoracentesis, closed-tube thoracostomy, rib resection with open drainage, and thoracotomy with decortication. We evaluated the use of radiographically guided percutaneous catheter drainage (PCD) in 18 patients with pleural collections from a variety of causes. Theoretically, guided drainage (rather than blind placement of a conventional surgical chest tube) ensures catheter placement within the fluid collection. We compared our experience with reported results in the literature.

## Materials and Methods

Eighteen patients underwent radiographically guided drainage of pleural fluid collections over a 5-year period. Catheter placement was guided by fluoroscopy in 10 cases, CT in seven cases (Fig. 1), and sonography in one case. Collections included 16 empyemas, one sterile transudate, and one hematoma. The 11 men and seven women were 30–82 years old (mean, 57 years). Ten (56%) were immunodepressed because of an underlying malignancy, a history of alcohol or drug abuse, a poor nutritional status, or a chronic medical condition.

Ten of the empyemas grew bacteria; the remainder showed an inflammatory exudate. Ten empyemas were associated with pneumonia. Four patients had postoperative empyemas after pulmonary lobectomies (one after foreign-body perforation of the esophagus and a lower lobe bronchus). One infected pleural hematoma developed after a traumatic diagnostic thoracentesis resulting in laceration of an intercostal vessel. One empyema was associated with steroid therapy in a patient with Stevens-Johnson syndrome. A sterile transudate of unknown cause was also drained. One sterile multilocular hematoma developed after excision of a chest wall granuloma. Nine of the patients underwent PCD after incomplete drainage by a surgically placed chest tube. Four fluid collections were associated with bronchopleural fistulas, and three were associated with malignancy.

Estimated duration of the fluid collection before drainage ranged from 2 days to 10 weeks (mean, 20 days). Free fluid collections were drained under fluoroscopy with the patient in the

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prone or lateral decubitis position. One percent lidocaine was used for local anesthesia, and tubes were introduced into the pleural space with a trocar through a subcutaneous tract formed by blunt dissection. Drainage catheters were placed over the superior margin of the most inferior rib to avoid the diaphragm and along the posterior lateral chest wall to provide dependent drainage.

With loculated collections, or collections near mediastinal structures, CT-guided insertion of a 0.038-in. (1-mm) guidewire into the pleural cavity was performed initially by using the Seldinger technique and the most direct route through the chest wall (Fig. 2). Patients were then transferred to the special procedure suite for catheter placement under fluoroscopy. Propyliodone (Dionosil, Glaxo Operations UK Ltd., Greenford, England) oily contrast material was injected to evaluate for bronchopleural fistulas and to define the cavity size in each case.

A variety of different drainage catheters were used. Three patients required two catheters. Fifteen received either a 12- or 14-French vanSonnenberg catheter (Medi-tech, Watertown, MA). In addition, the following catheters were used: three 8-French All Purpose Drainage (Medi-tech, Watertown, MA), two 9-French Sacks (Elecath, Newark, NJ), and one 10-French Cope (Cook, Bloomington, IN). In the more recent patients, we tended to use larger tubes; catheter exchanges were performed on only two occasions.

Tubes were remanipulated if a follow-up CT scan showed residual fluid, and additional tubes were placed as necessary to drain new collections. All catheters were part of a closed underwater seal drainage system. In cases of a bronchopleural fistula, an air leak, or a large drainage volume, wall suction was used. Three catheters were initially irrigated with small amounts of normal saline. Catheters were withdrawn in one step when drainage had removed less than 10 ml over 24 hr.

## Results

The duration of drainage ranged from 24 hr to 20 days (mean, 9 days). Twelve fluid collections completely resolved, for a cure rate of 67%. Of the six patients in whom PCD failed, an adequate trial of PCD was completed in three. These included two patients with empyemas and one with a multilocular hematoma. PCD was prematurely discontinued in the other three patients at the request of the referring

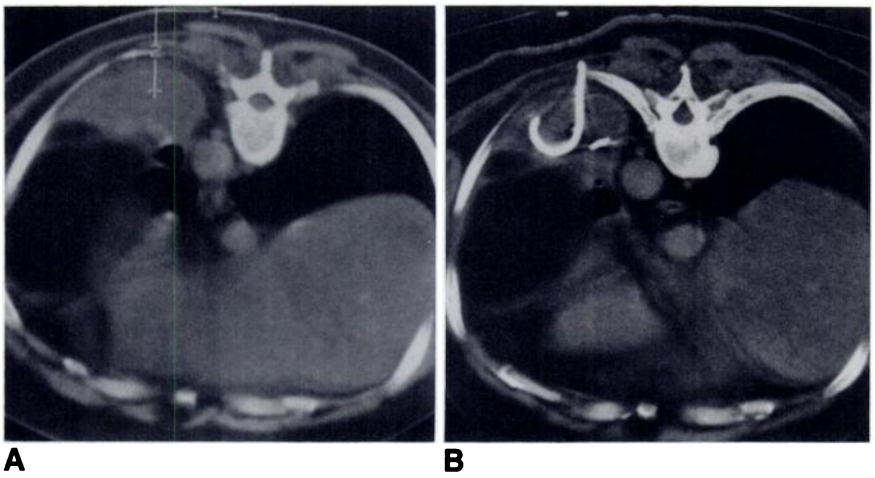



**Fig. 1.—CT-guided drainage of loculated left pleural effusion. Patient is prone.**
***A*, Predrainage CT scan localization. 1 = distance from midline; 2 = depth from skin.**
***B*, Placement of the percutaneous drainage catheter.**

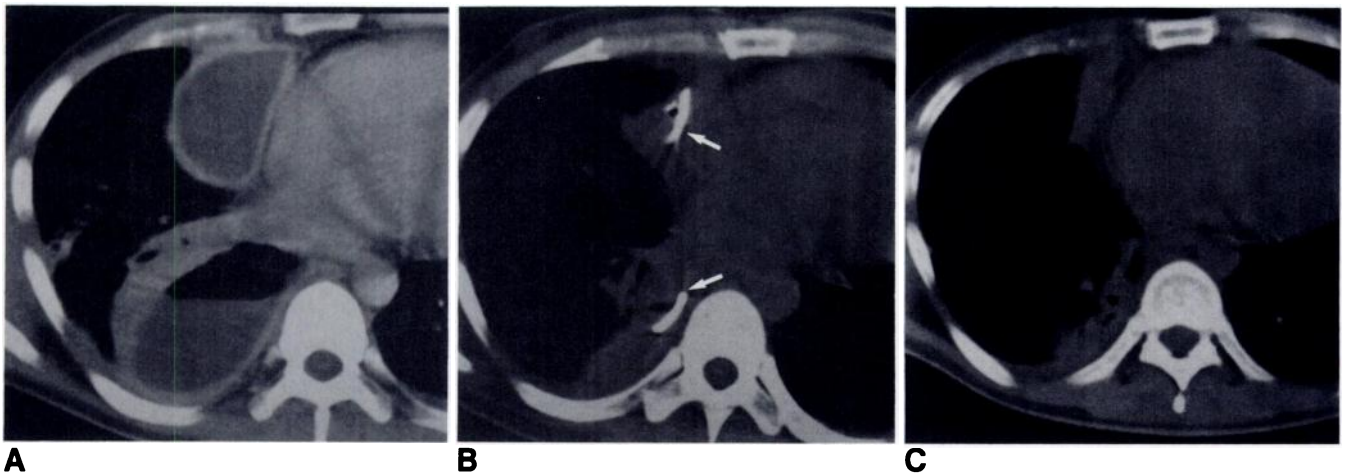



**Fig. 2.—CT scans show successful drainage of bilocular collection.**
***A*, Two loculated parapneumonic empyemas are adjacent to right mediastinum.**
***B*, After placement of drainage catheter (*arrows*) in each collection.**
***C*, Cavities collapse 2 weeks later and tubes are removed.**

physicians and/or patients. Two of these patients were referred for surgical drainage; the third died shortly after aggressive supportive therapy was discontinued. If we exclude these last three patients, 12 (80%) of 15 empyemas resolved. In one case, a small reaccumulation after tube removal resolved after two sonographically guided aspirations. In addition, four of the patients in whom drainage failed did show palliative clinical improvement, with a decrease in both their fevers and WBC counts.

Four patients had fluid collections with an associated bronchopleural fistula (Fig. 3). Two were diagnosed clinically because of a persistent air leak. Two were discovered by propyliodone sinography, one at initial tube placement and the other at a follow-up visit. In three patients, the bronchopleural fistulas closed and the fluid collections resolved.

Nine patients had prior incomplete drainage of fluid collections by surgical chest tubes (Fig. 4). Four of these were cured by radiographically guided percutaneous drainage. Of the five in whom drainage failed, two were in the subgroup of patients previously discussed who did not have an adequate trial of PCD.

PCD was performed for five postoperative fluid collections after thoracotomy, including four empyemas and one hematoma. One patient refused further PCD of an additional fluid collection; three of the others were cured.

Complications of PCD included one cardiopulmonary arrest at the time of catheter placement; resuscitation was successful. In one patient with multiple organ systems failure, aggressive supportive therapy was discontinued at the time of PCD, and the patient died 6 days later.

## Discussion

Radiographically guided PCD in the chest is as effective as conventional surgical chest tube drainage. Once successful, PCD obviates open drainage or thoracotomy and decortication.

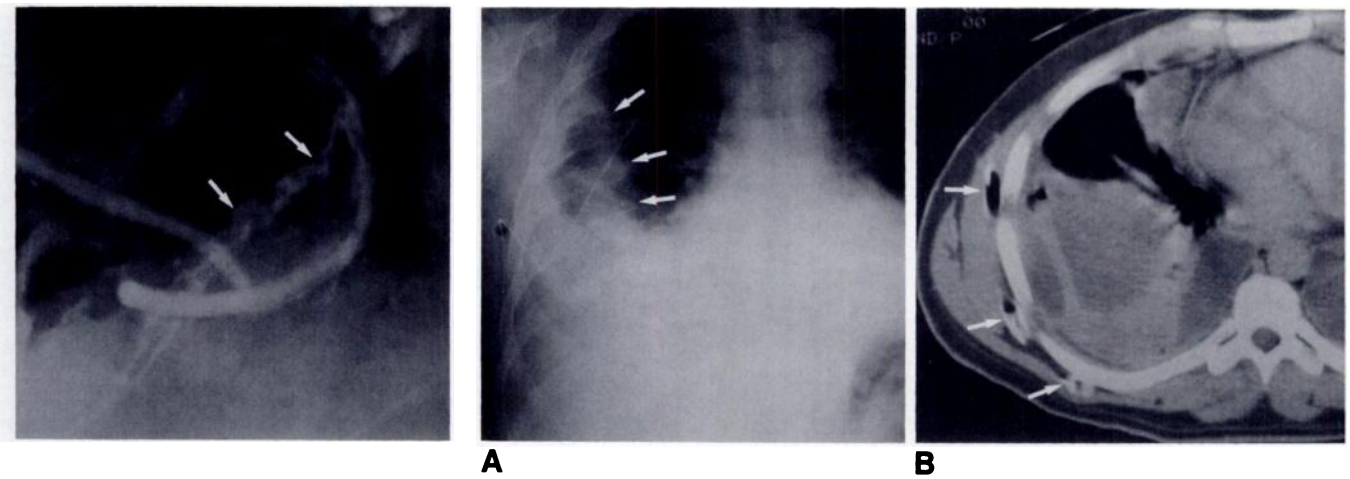
Radiographically guided percutaneous drainage successfully treated 80% of the empyemas in our series. vanSonnenberg et al. [2] and O'Moore et al. [3] each reported 88% success rates with guided drainage, and Wescott [4] successfully drained 92% of the empyemas in his series.

The success rate of conventional surgical chest tubes reported in the surgical literature varies. Mandal and Thadepalli [5] reported a 93% cure rate for patients treated by surgical chest tube alone. Their series was limited to patients with bacterial empyemas and excluded collections caused by trauma, surgical intervention, or esophageal or malignant thoracic disease. Most other series that included empyemas associated with these conditions reported success rates of 35–71% [6–9]. Wehr and Adkins [10] reported a curative rate of only 16% for surgical chest tube drainage.

PCD of postoperative empyemas after thoracotomy was curative in three (75%) of four patients given an adequate trial of drainage. This contrasts with the 12% and 29% success rates reported by others for closed surgical chest tube drainage after surgical intervention [6, 10]. Postoperative fluid collections are often small and loculated, so guided catheter placement is optimal.

Even with large, free-flowing pleural fluid collections, morbidity may increase when the surgical chest tube is placed in an interlobar fissure [11–13]. Nine patients were referred for guided catheter placement because prior surgical chest tube drainage had been incomplete. Four of these were cured by guided catheter placement. vanSonnenberg et al. [2] reported 76% of patients with empyemas in their series had prior unsuccessful chest tube drainage. PCD was curative in 92% of these cases. Westcott [4] reported a 100% success in four similar cases, emphasizing the importance of a guided approach for successful drainage.

Pleural catheters are part of a closed underwater sealed drainage system. Air leaks into the pleural space are potential hazards that could result in a pneumothorax. Cavity irrigation to remove as much particulate matter as possible is important



A B

**Fig. 3.—Importance of propyliodone oily contrast material. Injection of cavity shows communication with right lower lobe bronchus (*arrows*).**

**Fig. 4.—Failure of tube, placed without guidance, to drain pleural fluid.**
***A*, Chest radiograph shows persistent right pleural fluid after surgical chest tube placement (*arrows*).**
***B*, CT scan confirms extrapleural tube placement in soft tissues (*arrows*).**

with initial catheter placement, but irrigation should be minimized thereafter. When drainage ceases, catheters are withdrawn in one step rather than incrementally. A propyliodone contrast agent should be injected into the cavity at initial catheter placement and subsequent checks to evaluate for the possibility of a bronchopleural fistula. Two unsuspected bronchopleural fistulas were found in our series, and other authors have reported similar experiences [2]. Propyliodone avoids the risk of pulmonary edema when it does gain fistulous access to the lung.

Aggressive clinical and radiologic follow-up is necessary with PCD. Drainage needs to be checked daily and correlated with clinical parameters. Decreasing drainage without clinical improvement may signal a dislodged tube and undrained or new fluid collection. A follow-up chest CT scan should be obtained within 48–72 hr of catheter placement, and any undrained fluid collection should be treated with either fluoroscopic manipulation of existing catheters or placement of additional catheters.

One contraindication to PCD is an extensive multilocular pleural fluid collection, such as the multilocular hematoma in our series that could not be drained. These collections are better managed with open thoracotomy and decortication. However, a chronic empyema with a thick organized peel was not a contraindication to PCD. It has been reported closing a chronic thick-walled empyema cavity is impossible without surgery [9, 14]. However, in five of our successful empyema drainages, the fluid was subjectively enclosed by a thick fibrous peel. In our experience, chronicity of the fluid collection was not a contraindication to closed drainage.

Radiographically guided drainage of pleural fluid collections is successful in a high percentage of cases, and it ensures proper catheter placement compared with unguided surgical chest tube insertion.

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