

CT-GUIDED PERCUTANEOUS DRAINAGE OF LUNG ABSCESES: REVIEW OF 40 CASES

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Purpose: To evaluate the safety and effectiveness of CT-guided percutaneous drainage of lung abscesses considering success rate versus complications.

Methods: This retrospective study was carried out at Computed Tomography and Interventional Radiology Department of Sotiria Hospital, Athens, Greece, from 1/1/2007 to 1/1/2010. Forty patients with lung abscesses in which antibiotic therapy failed and were managed with CT-guided percutaneous drainage were included in the study. Catheter placement was carried out using Trocar technique in the majority of the cases.

Results: Lung abscess completely resolved with no residual cavity in thirty three patients. Seven patients had residual cavity and surgery was performed. Thus, the success rate of radiological drainage of the lung abscesses (33/40) was 83%. Five (13%) patients developed pneumothorax. Three developed moderate pneumothorax and chest-tube needed to be inserted and two patients developed mild pneumothorax which was managed with aspiration. These patients were kept under observation and followed-up by chest X-rays. No other complications and no mortality occurred during the procedure for all the forty patients.

Conclusion: CT-guided percutaneous catheter drainage is a useful and safe procedure for the treatment of patients with lung abscesses who do not respond to medical therapy and should be considered a valuable alternative to open surgery.

Key words: Lung abscesses – Abscess, percutaneous drainage.

Lung abscess is defined as a localized area of liquefactive necrosis of the pulmonary tissue and formation of cavities containing necrotic debris or fluid caused by microbial infection (1).

Although 80-90% of pyogenic lung abscesses are now successfully treated with antibiotics (2), occasionally this conservative therapy may fail (3-5), which could be due to the virulence of the responsible pathogens or failure to achieve an adequate concentration of antibiotics within the abscess cavity (2, 6, 7). Severe underlying lung disease and decreased lung compliance may play a role in the failure of an abscess cavity to drain spontaneously and hence failure of medical therapy (2, 6). Image guided percutaneous catheter drainage of intrapulmonary air and fluid collections is an alternative treatment option with less morbidity and mortality than surgical resection of intrapulmonary lung abscess of those patients who do not respond to medical therapy. The use of CT allows optimal characterization of intrapulmonary collection, optimal catheter placement and enables safe and effective evacuation.

The purpose of the present retrospective study was to evaluate the results of CT-guided percutaneous

drainage for lung abscesses in a hospital of chest diseases (Sotiria General Hospital of Chest Diseases, Athens, Greece) over a period of 36 months.

Patients and methods

The medical and radiological files of all patients with lung abscesses who underwent percutaneous drainage under CT guidance from 1/1/2007 to 1/1/2010 at Computed Tomography and Interventional Radiology Department of Sotiria Hospital of Chest Diseases, Athens, Greece were reviewed. The study was approved by the appropriate ethical committees related to the hospital and all the forty patients that were included in it gave informed consent to the work. Twenty eight patients had lung abscesses due to bacterial pneumonia and twelve due to tuberculosis (TB) and all were diagnosed by computed tomography with intravenous contrast media.

Maximum transverse diameter of the abscess was 4-6 cm in 13 patients, 6-8 cm in 16 patients and bigger than 10 cm in 11 patients. Ten patients had abscess at right upper lobe, twelve patients at right lower lobe, seven patients at left upper lobe and eleven patients at left

lower lobe. In thirty three patients, abscess was peripherally located adjacent to pleura and in the rest deeply placed with intervening lung in between.

All procedures used pigtail catheter chest tubes (8F to 12 F). The size of the catheter depended on the maximum transverse diameter of the abscesses. A direct trocar method was usually used for tube insertion, after the puncture site was sterilely prepared and anesthetized; however, a modified Seldinger technique was also used in some cases when there was difficulty for the accurate placement of the catheter. For the modified Seldinger, once the puncture site was sterilely prepared and anesthetized, 18-gauge lumbar puncture needle was placed through the chest wall into the abscess cavity and aspiration of pus confirmed the adequate positioning of the needle. A 0.035 guide wire was then introduced through the needle. Serial dilation and pigtail catheter insertion were performed using the guide wire. The catheter was secured in the place by suturing (8) and was connected to a continuous suction drainage system (minus 20 cm of water). Flushing the tube with 15 ml of sterile saline three times daily was usually prescribed to assure patency of the tube. It has to be mentioned that complete evacuation by aspiration of the abscess cavity was not performed on CT table because it can result in severe hemoptysis.

After the procedure, repeated CT images were taken to confirm the correct catheter placement. Day-to-

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Table 1. — Data for the 40 patients undergoing CT-guided transthoracic catheter drainage of intrapulmonary abscess.

Patient no	AGE(years)	SEX	LOBE	SIZE (cm)	CATHETER	PUS CULTURE	COMPLICATIONS	FURTHER MANAGEMENT
1	64	M	LUL	< 8	10F	KL	Mild pneumothorax	Surgery
2	26	W	RLL	> 10	12F	SA		
3	51	M	LLL	< 8	10F	SA		
4	44	W	RUL	< 8	10F	MT		
5	59	M	RLL	< 8	10F	MT		
6	77	W	RUL	< 8	10F	KL		
7	70	M	LLL	< 8	10F	SA		
8	58	M	LLL	> 10	12F	MT		
9	60	M	RLL	< 6	8F (S)	SA		Surgery
10	49	M	RUL	< 6	8F (S)	KL		
11	50	W	LUL	< 8	10F	KL		
12	88	M	LLL	< 8	10F	MT		
13	76	M	RUL	< 6	8F	SA	Moderate pneumothorax	Chest-tube inserted
14	79	M	RLL	< 8	10F	SA		
15	57	W	LLL	< 8	10F	MT		
16	37	M	RUL	< 6	8F	KL		
17	45	M	LUL	< 6	8F (S)	MT		
18	64	M	LLL	< 8	10F	SA		
19	70	M	RLL	< 8	10F	SA		
20	66	M	RLL	> 10	12F	SA		Surgery
21	61	M	RLL	> 10	12F	KL		
22	42	W	LUL	< 8	10F	MT		
23	47	M	RUL	< 8	10F	KL	Moderate pneumothorax	Chest-tube inserted-Surgery
24	79	M	RLL	< 8	10F	MT		
25	48	M	LUL	< 6	8F (S)	SA		
26	52	M	RUL	< 6	8F	SA		
27	56	W	LLL	> 10	12F	MT		
28	66	W	RUL	< 6	8F	SA		
29	56	M	RLL	> 10	12F	KL	Mild pneumothorax	
30	60	M	LLL	< 6	8F	MT		
31	65	M	RLL	> 10	12F	SA		
32	67	M	LUL	< 6	8F (S)	SA		
33	72	W	RLL	> 10	12F	KL		Surgery
34	81	M	RLL	< 6	8F	SA		
35	59	M	LLL	> 10	12F	SA	Moderate pneumothorax	Chest-tube inserted
36	58	M	LLL	> 10	12F	KL		
37	67	M	LUL	< 6	8F (S)	SA		Surgery
38	77	M	RUL	< 8	10F	MT		
39	73	W	LLL	> 10	12F	MT		
40	64	M	RUL	< 6	8F (S)	SA		Surgery

M = male
W = woman

RUL = Right Upper Lobe
RLL = Right Lower Lobe
LUL = Left Upper Lobe
LLL = Left Lower Lobe

F = French
S = Seldinger

SA = Staphylococcus Aureus
MT = Mycobacterium Tuberculosis
KL = Klebsiella Pneumoniae

day follow-up of the patient was usually done by the referring physician, including clinical observations, daily tube output measurements, and repeated radiographs and, when necessary, repeated computed tomography with contrast media. Catheter was left in place until the drainage of the pus from the catheter was stopped. Patients were followed till imaging evidenced complete closure of the abscess cavity or decision of surgery was taken due to non closure of the abscess cavity.

Success of chest tube drainage was defined as complete closure of the abscess cavity with clinical improvement and avoidance of more invasive procedures (surgery etc). Ideally, there should have been no more than 20 ml of daily drain output.

Results

Thirty patients with lung abscess were men and ten were women. The age range was 26-88 years (mean age 61 years). The decision for the drainage was made due to persistent fever and leucocytosis 1 week after initiation of antibiotic therapy for patients with bacterial pneumonia and due to increase of the size of the abscess while the patient was on medical therapy for patients with diagnosed tuberculosis (9).

Immediate technical success was achieved in all the 40 patients. We used the Seldinger technique for tube insertion in seven patients while the direct trocar technique was used in all the other cases. Overall we used thirteen 8F, sixteen 10F and eleven 12F pigtail catheters for the drainage of the lung abscesses.

Out of the forty patients, two (5%) developed mild pneumothorax which were managed with aspiration of 200cc of air and administration of supplemental oxygen, while three (8%) developed moderate pneumothorax and chest tube was inserted, and all these three patients had deeply placed abscesses and normal lung tissue had to be traversed to acquire access to the abscess cavity. All the patients showed clinical improvement with resolution of pulmonary symptoms and sepsis (regression of fever, decrease of white blood cell counts). Seven of them (two of them had developed pneumothorax during the procedure), although they demonstrated initial shrinkage of the abscess and clinical improvement, a few weeks later showed recurrence of the

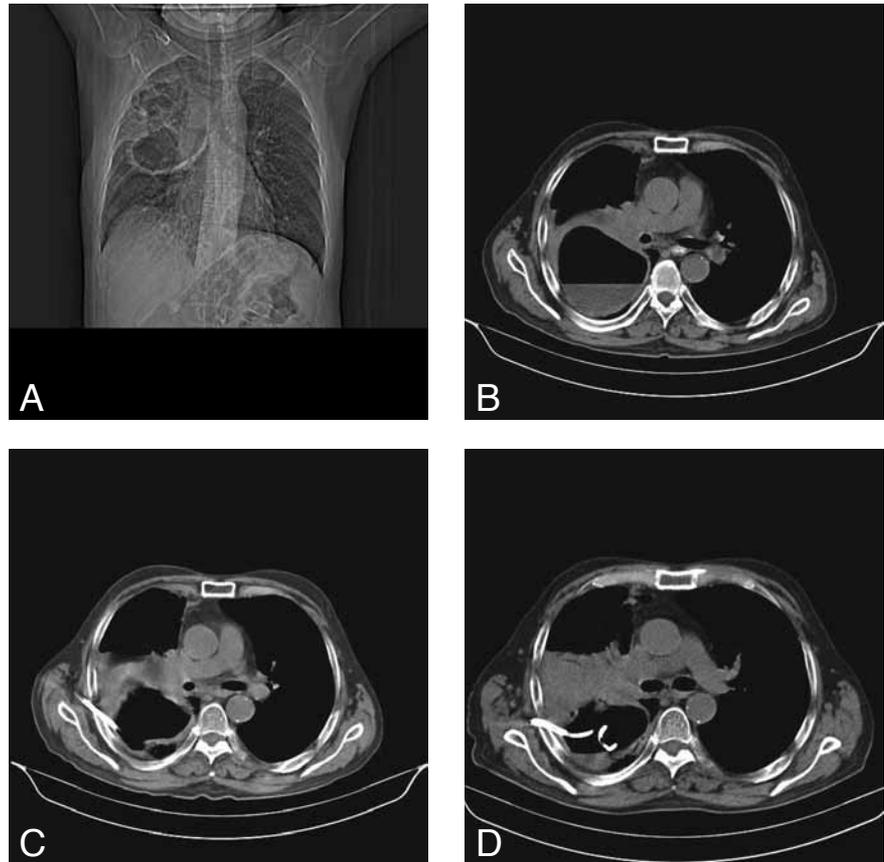


Fig. 1. — 61-year-old man with right lung abscess and failed medical treatment.

A,B. Chest radiograph and CT scan (mediastinal window) show a cavitory lesion with air-fluid level almost filling the right hemithorax representing an abscess. C. CT scan after percutaneous drainage shows immediate decrease in fluid and size of lung abscess. The patient had a rapid symptomatic response to abscess drainage. D. Follow-up CT scan 6 days after the procedure shows almost complete drainage of the fluid. The abscess cavity completely resolved 3 weeks later and the patient did not need further surgical management.

abscess and needed surgery while the other thirty three patients avoided it. Thus the success rate of the procedure was 83% (33/40) (Fig. 1, 2). Among the thirty three patients who avoided surgery, three needed insertion of extra catheter during the initial procedure due to the presence of multilocular abscess. None of all the forty patients either developed haemoptysis, or was found to have bronchopleural fistula or empyema formation and no mortality occurred during or after the procedure.

In thirty out of forty patients, complete resolution of abscess cavity occurred in 4 weeks. In the three patients who needed extra catheter it took 6 weeks and in seven patients abscess cavity persisted 9 weeks till they were operated.

The pus culture revealed the presence of *Mycobacterium tuberculosis* in 12 patients, *Staphylococcus*

aureus in 18 patients and *Klebsiella pneumoniae* in 10 patients.

Discussion

Primary lung abscess usually results from aspiration of anaerobic oropharyngeal bacteria into gravity-dependent portions of the lung, most often the posterior segments of the upper lobes and the superior segments of the lower lobes. Consequently, they are seen more commonly in alcoholics and patients with altered levels of consciousness, gastro-esophageal dysmotility and poor dental hygiene (10). Most lung abscesses in paediatric patients are believed to develop secondary to bacterial pneumonia. Other predisposing factors for development of a lung abscess include immunodeficiency or immunosuppression state caused by viral infection,

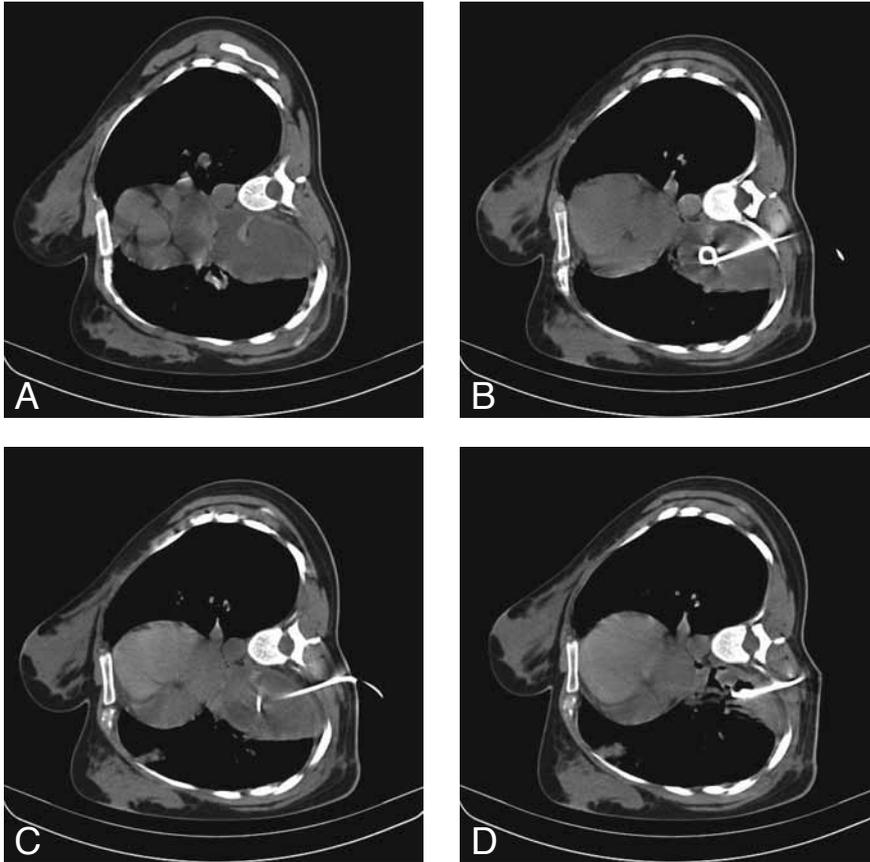


Fig. 2. — 26-year-old woman with lung abscess in the right lower lobe and persistent fever 1 week after institution of antibiotic therapy. A. CT scan shows posterior loculated fluid collection with thick and irregular wall consistent with abscess (the patient is in right lateral decubitus position). B,C. CT-guided percutaneous drainage of the abscess. D. Follow-up CT scan after the procedure shows almost complete drainage of the fluid.

severe systemic illness or steroid therapy. Less common causes are cystic fibrosis, α -1 antitrypsin deficiency, anaesthesia and dental surgery (11). Most abscesses are discovered when fever and pulmonary symptoms lead to a chest radiograph that reveals a solid or cavitary lung mass.

CT scans are obtained in all patients with suspected lung abscess to further characterize findings detected on conventional radiographs and to evaluate for obstructing endobronchial lesions. On CT, a lung abscess appears as a rounded intrapulmonary mass that contacts the chest wall at acute angles and contains central necrosis or cavitation. The enhancing wall of an abscess on CT is typically thick with an irregular inner margin (12).

Until the early 1940s, surgical pneumonotomy and drainage were the accepted treatments for lung abscess (13). Subsequent advances in anesthesia and surgical techniques led to the advent of lung

resection as the preferred therapy, until availability of effective antibiotics rendered open drainage unnecessary in most patients (14). Current first-line therapy for lung abscess is antibiotic therapy directed at the likely causative organisms, usually anaerobes or mixed aerobic and anaerobic bacteria (15). Surgical or percutaneous drainage is required in 11% to 21% of patients with lung abscess who fail to respond to medical therapy (16).

Image guided percutaneous catheter drainage is an alternative to traditional surgical management of lung abscess, and is safe and effective with less morbidity and mortality than surgical resection. Other advantages are rapid clinical and radiological improvement of pyogenic abscess which may avoid complications that can occur with prolonged and conservative treatment (2, 8).

Lung abscess may be drained using fluoroscopy or ultrasound guidance, but CT guidance was pre-

ferred in this study. Reasons being, CT is usually performed in all patients with lung abscess before transthoracic placement of the drainage catheter (4). CT is useful in evaluation of the intrathoracic abnormality and helps to differentiate it from necrotizing pneumonia. This is important because catheter drainage of necrotizing pneumonia has proved to have a higher complication rate like hemorrhage, bronchopleural fistula and pneumothorax (17). CT is optimal in determining the wall thickness of an abscess, contents of an abscess and its relationship to the adjacent lung and pleura. More over, any obstructing foreign body or endobronchial neoplasms can also be visualized. Before considering the failure of medical therapy and the need of percutaneous transthoracic drainage it is important to rule out

bronchial obstruction and bronchogenic malignancy as these are indications of surgical resection (18). Follow-up CT studies after placement of percutaneous catheter allow optimal assessment of the adequacy of pus drainage and help in determining whether an additional catheter is required (8).

Duration of complete closure of cavity is variable and has been reported to occur as early as 4 days (9) or as long as 12 weeks (3), but usually it takes 4 to 5 weeks (2, 6) as occurred in our study.

In our study, thirty three of the forty patients with lung abscess were saved from surgery which means that success rate of this procedure is 83%. These results are comparable to the results of the largest series published to date. Van Sonneberg et al. (8) reported successful CT guided percutaneous lung abscess drainage in 19 patients, and surgery was avoided in 16 patients (84% success rate). Surgery was performed in three patients because of adjacent organized pleural tissue that could not be drained via percutaneous catheters. Complications that occurred in Van Sonnenberg study were haemothorax (occurred in one patient, who required chest tube for drainage), clogging of catheter (occurred in two patients, who required catheter exchange) and transient elevation of intracerebral pressure (one patient).

Mahira Yunus (1) also reported successful CT-guided transthoracic catheter drainage of intrapulmonary abscess in 19 patients and surgery was avoided in 15 patients (78,94% success rate). Two patients with

residual cavity and two with bronchopleural fistula were operated, while two patients developed moderate pneumothorax and required chest tube insertion, three patients developed mild pneumothorax and two patients developed mild haemoptysis which both needed no further management.

In this study we used the trocar technique for tube insertion in the majority of cases but also Seldinger technique in seven patients, when there was difficulty in the right placement of the catheter. Although some authors in the literature state (8) that the Seldinger technique with placement of catheter over guide wire decreases the likelihood of complications, considering the fact that the complications which occurred during the procedure for all the patients of the series were few and minor (Only five patients with lung abscesses developed mild or moderate pneumothorax), we believe that the choice of technique is depended on the ability, the experience and also the preference of the interventional radiologist performing the procedure.

Conclusion

CT-guided percutaneous catheter drainage is a useful and safe procedure for the treatment of lung abscesses and should be considered both as a preparatory step for surgery and a valuable alternative to

open surgery. Failure of the procedure does not, however, preclude a subsequent surgical operation.

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