

### Simple Construction of a Subcutaneous Catheter for Treatment of Severe Subcutaneous Emphysema\*

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**Subcutaneous emphysema often presents a management dilemma. Rarely, subcutaneous emphysema has pathophysiologic consequences. More often, it is extremely uncomfortable for the patient, and is often disfiguring and alarming for patients and family. When subcutaneous emphysema is severe, physicians may feel compelled to treat it, but the currently described techniques are often invasive or ineffective. We describe the use of an easily constructed, minimally invasive, fenestrated catheter that relieves the symptoms of subcutaneous emphysema.**

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**Key words:** AIDS; complications; *Pneumocystis carinii* pneumonia; pneumothorax; subcutaneous emphysema; therapy

Subcutaneous emphysema often presents a therapeutic dilemma when it progresses beyond the stage of tactile fascination. Even when it is severe, subcutaneous emphysema rarely has pathophysiologic consequences, but it is extremely uncomfortable for the patient, and physicians may feel compelled to treat it. The widely employed methods of therapy, which include placing chest tubes,<sup>1</sup> or lacerating the skin on the anterior chest,<sup>2</sup> are time-consuming and uncomfortable. The lacerations often clot and, thus, are ineffective, frequently leaving scars. Here, we describe the use of an easily constructed fenestrated catheter that relieves subcutaneous emphysema.

#### CASE REPORT

A 50-year-old man presented to his family doctor with an exacerbation of COPD. He was initially treated with albuterol and oral steroid therapy (40 mg po once daily, then tapering). The patient's medical history was noncontributory, except for a 50 pack-year smoking history, and he had lost approximately 20 lb

over the previous 2 to 3 months. Within a few days, fevers, chills, rigors, and a dry cough developed. He was admitted to the hospital in respiratory distress. His chest radiograph at hospital admission showed signs of bullous lung disease and bilateral fine reticular infiltrates. The working diagnosis was COPD and community-acquired pneumonia, and he was started on cefuroxime and erythromycin therapy. His condition deteriorated, and bronchoscopy and a transbronchial biopsy were performed. *Pneumocystis carinii* was confirmed by testing of the biopsy specimen, and he was started on therapy with trimethoprim/sulfamethoxazole and corticosteroids. The results of his HIV serology tests were positive. Following the biopsy, his condition continued to deteriorate, and he was transferred to the ICU because of respiratory failure. He required intubation, and two chest tubes were inserted for a large right pneumothorax.

Over the next 5 weeks, the patient had numerous chest tubes inserted for recurrent pneumothoraces and a persistent air leak with subcutaneous emphysema. After 5 weeks and 12 chest tubes, the patient refused to have any additional chest tubes placed, and he had declined a surgical consultation. However, the subcutaneous emphysema was severe enough to completely close his eyes and made it difficult for him to breathe and swallow (Fig 1). The patient did not want to live if he could not see his family. Thus, no further intervention was attempted, and the subcutaneous emphysema worsened over the subsequent 7 days. The patient continued to refuse surgery and the placement of further chest tubes, and he stated that he would discharge himself and commit suicide if nothing could be done. Subcutaneous punctures relieved the emphysema for a few hours until the blood clotted or the wound healed over. A literature search failed to reveal any additional techniques that were acceptable to the patient.

With the patient's consent, we created fenestrations in two 14-gauge angiocatheters (Fig 2) and inserted them into the subcutaneous space bilaterally at the midclavicular line overlying the second intercostal space. The angiocatheters were placed using a sterile technique and were fastened into place with 3-0 silk suture. The angiocatheters relieved the subcutaneous emphysema, and this greatly improved the patient's spirits (Fig 1). There were no signs of infection at the angiocatheter sites and no pain from the angiocatheters. The subcutaneous emphysema and pneumothorax resolved in 3 days, and the angiocatheters were removed after 5 days. There was no further recurrence of either the pneumothorax or the subcutaneous emphysema. The patient was discharged 4 days later and lived at home for an additional 1.5 years until his death from sepsis.

#### DISCUSSION

The catheters are easily constructed. The fenestrations are readily created by leaving the angiocatheter over the steel stylette and using a scalpel blade to create the holes. To enhance the rigidity of the catheter, the fenestrations are created in a spiral pattern. A povidone-iodine swab is used to prepare the skin and, if desired, a small amount of local anesthetic can be used. The site of insertion is 2 to 3 cm lateral to the midclavicular line over the third rib. The catheter is inserted medially at a 45° angle until the tip is

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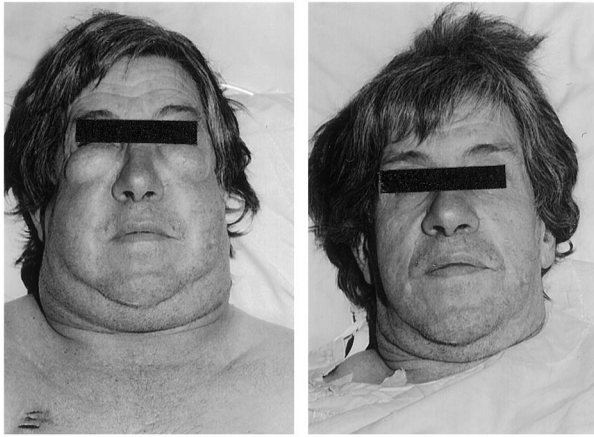


FIGURE 1. The appearance of the patient before (*left*) and 4 days after (*right*) the placement of bilateral fenestrated subcutaneous catheters. Note that lacerations on the anterior chest can be seen in the picture taken before catheter placement, which did not control the subcutaneous emphysema. The patient described in this report provided informed consent for the procedures and for the photographs.

approximately 0.5 to 1 cm deep into the skin that has been expanded by the subcutaneous emphysema. The angle of insertion then is decreased, and the catheter is directed medially so that it is completely inserted and the tip is approximately 1 to 1.5 cm deep into the skin.

For subsequent patients, the catheter was not sutured into place but was held in place with a 2 × 2-inch gauze pad taped over the end of the catheter, which allows for the free escape of subcutaneous air. Precautions should be used to keep the catheter clean, and at the first sign of any infection the catheter should be removed (a new catheter can be placed in a new site if needed).

The patient described here had had numerous chest tubes placed and refused further insertions. It is likely that the air leak resolved at about the time that the subcutaneous catheters were placed. It is interesting to note that the pneumothorax also resolved following the placement of the subcutaneous catheters. The catheters likely work by providing a portal for air to exit along well-defined tissue planes. Although the subcutaneous catheters were draining the pleural air as well as the subcutaneous air, the process resolved much more quickly than we would have

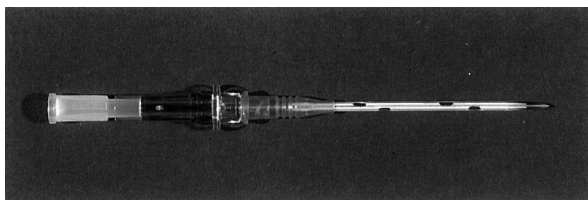


FIGURE 2. Fenestrations were cut in a spiral pattern along the length of a 14-gauge angiocatheter. No more than eight holes were cut into the catheter so that it retained strength. Care was taken to remove any burrs so that the catheter could be easily inserted and removed.

expected for either condition. In subsequent patients with continuing air leaks, we have found that the catheters improve the subcutaneous emphysema but may not improve the pneumothorax.

The mechanism of pulmonic interstitial emphysema, pneumomediastinum, and subcutaneous emphysema has been studied experimentally.<sup>3,4</sup> In studies of a variety of diseases and in animal models, it has been demonstrated that air leaks from ruptured alveoli into the loose connective tissue surrounding the pulmonary vasculature and tracks along the perivascular space to the mediastinum. In this classic work,<sup>3,4</sup> the authors were unable to demonstrate the presence of air along the peribronchial sheath, along the lymphatics, or along the septa of the secondary lobules. Further, they thought that, even in the setting of an iatrogenic pneumothorax, pneumomediastinum and subcutaneous emphysema were more likely to be the result of pulmonic interstitial emphysema than the direct movement of air from the pleural space to the subparietal space through a tear in the parietal pleura. By inference, air then tracks from the mediastinum to the loose subcutaneous tissue, causing subcutaneous emphysema.

A number of techniques have been employed to treat subcutaneous emphysema, many of which are invasive or uncomfortable, and may themselves cause subcutaneous emphysema.<sup>5</sup> These include infraclavicular incisions,<sup>2</sup> the placement of additional chest tubes either in the intrapleural space or subcutaneously,<sup>6</sup> tracheostomy,<sup>7</sup> and large-bore subcutaneous drains with or without suction.<sup>8,9</sup> The catheter described here does not require an incision, does not require suction, and is less likely to produce a scar than the previously described techniques. While we have not experienced problems with the catheter described here, there are two potential problems. The first is infection, and the second is that the catheter may become blocked with blood. Because the catheter is easily replaced in a slightly different location, our policy has been to replace the catheter at the first sign of any problem.

Subcutaneous emphysema, even when severe, is often nothing more serious than a cosmetic problem. Certainly, it can make nursing care difficult because the patient may develop dysphagia<sup>10</sup> or vision problems because of periorbital swelling, as did our patient. More severe complications have been rarely reported. These complications include respiratory failure,<sup>11,12</sup> pacemaker malfunction,<sup>13,14</sup> airway compromise,<sup>15,16</sup> and tension phenomena.<sup>8,17,18</sup> Under these conditions, the catheter described here, or other previously described techniques, should be employed rapidly. The ease of construction of the catheter described here will allow physicians to treat subcutaneous emphysema earlier in its course and prevent severe complications.

In summary, we describe a simply constructed catheter that can be used for subcutaneous emphysema. It is made with equipment that is available on most medical wards and can be easily placed by the physician at the bedside. The goal is to relieve the discomfort and to prevent complications associated with subcutaneous emphysema.

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## Autopsy Findings of Heart and Lungs in a Patient With Primary Pulmonary Hypertension Associated With Use of Fenfluramine and Phentermine\*

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**A 36-year-old woman (height, 157 cm; weight, 117 kg; body mass index, 47.5) received fenfluramine and phentermine (fen-phen) for 7 months, and pulmonary hypertension subsequently developed. Her pulmonary arterial pressure was 56 mm Hg, and echocardiography showed right ventricular dilatation and hypokinesia. Cardiopulmonary arrest developed during right-heart catheterization, and she died 3 days later. At autopsy, right ventricular dilatation with fibroproliferative tricuspid valve was identified. The pulmonary arteries, including the main arteries and elastic arteries to the arterioles, revealed fibroproliferative plaque; the latter was more severe and more prominent in the upper lobes than in the lower lobes. Combined cardiac valvular disease and pulmonary hypertension appear to occur frequently in patients receiving fen-phen, and more autopsy cases of patients with a history of fen-phen usage are warranted to document the frequency of combined cardiac valvular disease and pulmonary hypertension in the United States.**

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**Key words:** cardiac valvular disease; fenfluramine; phentermine; pulmonary hypertension

**Abbreviations:** fen-phen = fenfluramine and phentermine; PPH = primary pulmonary hypertension

**P** primary pulmonary hypertension (PPH) is rare, occurring in about two patients per 1 million population.<sup>1</sup> The incidence increases 30-fold in obese female patients who have received fenfluramine and phentermine (fen-phen) for > 3 months.<sup>1,2</sup> Fen-phen usage has attracted public attention in the United States, as it causes cardiac valvular lesions involving both the right-sided and left-sided cardiac valves.<sup>3,4</sup> We report the heart and lung autopsy findings in a documented case of PPH in a 36-year-old woman who received fen-phen for 7 months.

### CASE REPORT

A 36-year-old woman (height, 157 cm; weight, 117 kg; body mass index, 47.5) was transferred from the outpatient cardiac

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