

Bronchoscopic management of bronchopleural fistula with intrabronchial instillation of glue (N-butyl cyanoacrylate)

Rakesh K. Chawla, Arun Madan¹, P. K. Bhardwaj², Kiran Chawla³

Department of Respiratory Medicine, Critical Care and Sleep Disorders, Jaipur Golden Hospital, Rohini, Delhi, ¹Professor and Head, Department of Respiratory Medicine, Sharda Medical College and Hospital, Noida, UP, ²Department of General and Laparoscopic Surgery, Saroj Hospital, Rohini, New Delhi, ³Quality Assurance Coordinator, Jaipur Golden Hospital, Rohini, Delhi, India

ABSTRACT

Context: Bronchopleural fistula (BPF) is a communication between the pleural space and bronchial tree. **Materials and Methods:** A series of 9 cases are reported where BPF was identified and managed with intrabronchial instillation of glue (N-butyl-cyanoacrylate) through a video bronchoscope. **Results:** Out of 9 patients the BPF was successfully sealed in 8 cases (88.88%). In 1 patient of postpneumonectomy, the fistula was big, that is >8 mm who had a recurrence after the procedure. In one case of pyopneumothorax the leak reduced slowly and it took us 14 days to remove the intercostal drainage tube. Rest of the patients had a favorable outcome. No complications were observed in a follow-up of 6 months. **Conclusions:** In our opinion, it is a cost-effective, viable, and safe alternative compared with costly, time-consuming, and high-risk surgical procedures.

KEY WORDS: Bronchopleural fistula, intercostal drainage tube, N-butyl cyanoacrylate glue, video bronchoscopy

Address for correspondence: Dr. Rakesh K. Chawla, Chawla Respiratory Care, Allergy, Sleep Disorders and Research Centre, 58-59/C-12/Sector-3, Rohini, Delhi-110 085, India. E-mail: chawla.rakesh@rediffmail.com

INTRODUCTION

A bronchopleural fistula (BPF) is a communication between the pleural space and the bronchial tree. It occurs rarely but represents a challenging management problem and is associated with significant morbidity and mortality. Most recently, Sato and colleagues^[1] represented their experience with postoperative BPF and they found BPF in 5 of 64 cases (7.8%) of inflammatory diseases and 19 of 481 cases (4%) of lung cancer. In lung cancer patients, BPFs are associated with advanced stage, residual tumor on the stump and intrathoracic use of chemotherapy. The incidence is highest in patients who undergo right pneumonectomy and right lower lobectomy. Most of the fistulas are seen on the stump besides the residual lobe.^[1] BPF results from various causes, one of them being the

postoperative complication of pulmonary resection followed by necrotic lung infections, hemorrhages or radiotherapy (for lung cancer).^[2]

Preoperative risk factors for the development of BPF are fever, steroid use, *Haemophilus influenzae* in sputum, elevated erythrocyte sedimentation rate, anemia, leukocytosis, tracheostomy, and bronchoscopy for sputum suction/mucus plugging. Since there are no guidelines or consensus to treat BPF, the treatment option is individualized with therapeutic options that range from conservative therapies to surgical procedures that often prove to be quite disabling.^[3] Localization and size of the fistula may be the decisive factors to choose between surgical versus endoscopic procedures and of particular interest is the use of bronchoscopy with different glues, coils and sealants, which provides a safe, quick, cost-effective and a relatively noninvasive and successful mode of treatment in selected group of patients.^[4] We have used glue (N-butyl cyanoacrylate) in our series of 9 cases of BPF with pneumothorax.

In high-risk surgical patients endoscopic procedure may serve as a temporary bridge until the patients' clinical status is improved, whereas in other patients endoscopic

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procedures may be the only option. Therapeutic success has been variable and the lack of consensus suggests that no optimal therapy is available rather the current therapeutic options seem to be complimentary and the treatment should be individualized.

MATERIALS AND METHODS

Patients in whom BPF persisted for more than 15 days and were unfit for surgery were selected for intrabronchial glue therapy. Details of the procedure, its benefits, and chances of failure with the patients and relatives were discussed in detail. BPF was suspected by seeing air bubbles in the intercostal drainage tube (ICD) with underwater seal system, and the site of the leak was confirmed by examining the affected bronchial segment on bronchoscopy. Bronchoscopy was done as per the British Thoracic Society^[5] guidelines with continuous O₂ monitoring. The site of the leak was directly seen in all the patients with malignancies and road-traffic accidents. Air bubbles could be seen coming through the leak [Figures 1 and 2].

We used glue (*N*-butylcyanoacrylate) available commercially with the name of Injection Encorate in ampoules of 0.25 and 0.5 mL. It is in the liquid form of light blue color. We filled it in the syringe in total dry conditions because if it comes in contact with humidity or liquid it gets solidified, so the technician was instructed to maintain totally dry conditions and be ready with the glue in syringe.

Transbronchial needle aspiration (TBNA) catheter, which is used for diagnostic aspiration from mediastinal lymph node was used to deliver the glue. It is cost-effective as compared with other polyethylene catheters or Swan-Ganz catheter. The TBNA catheter of 1.8 mm diameter was passed through the working channel of bronchoscope keeping the needle of the catheter in the sheath and placed directly over the site of the leak.

A 0.5–1.5 mL of *N*-butyl cyanoacrylate glue was instilled directly under vision after taking all the precautions, that is, keep the bronchoscope at least 4 cm away from the tip of catheter so that there is no spillage of glue over the bronchoscope, and if it happened, then the scope was cleaned immediately with acetone, which is known to dissolve the glue. After instillation of the glue, flexible fiber-optic bronchoscopy was repeated to reconfirm the placement of glue.

In the chronic obstructive pulmonary disease (COPD) patients who had spontaneous pneumothorax with BPF, bronchoscopy was done and individual bronchial segments were selectively occluded by inflating the intrabronchial balloon. That segment was selected where the air leak stopped in the underwater seal drainage system after expansion of the balloon and glue was instilled intrabronchially under vision. After ensuring the expansion of the lung by chest X-ray, ICD was clamped for 2 or more days, chest X-ray repeated and if there was no recollection of air in the pleural space, ICD was removed. It took an average 4–5 days to remove the underwater seal

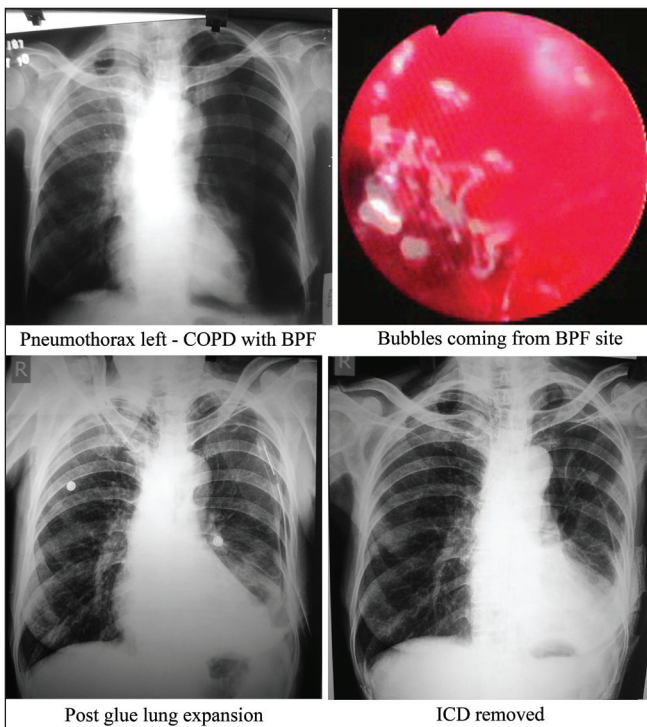


Figure 1: Pneumothorax with bronchopleural fistula

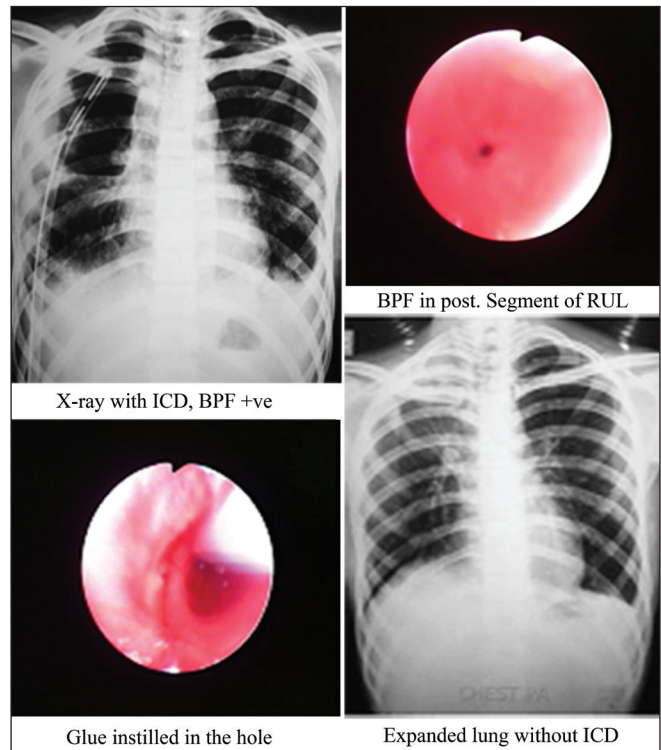


Figure 2: RTA with bronchopleural fistula

Table 1: Details of patients

Age	Sex	Diagnosis	Technique of detection of BPF	Amount of glue in (mL)	Complications in 6 months	Intercostal drainage tube removed after	Size of the leak (mm)	Indication	Results
68	M	NSCCL (pneumectomy)	Direct visualization of stump	0.5	NIL	72 h	3	Air fluid level postpneumectomy	Successful
65	M	NSCCL (pneumectomy)	Direct visualization of stump	0.5	NIL	4 days	3	Air fluid level postpneumectomy	Successful
70	M	NSCCL (pneumectomy)	Direct visualization of stump	1.5	NIL	Not removed	8	Air fluid level postpneumectomy	Unsuccessful
28	M	RTA postlobectomy	Direct visualization of stump	1	NIL	48 hrs	2	Persistent leak in under water drainage system	Successful
27	F	RTA postlobectomy	Direct visualization of stump	0.5	NIL	48 h	2	Persistent leak in under water drainage system	Successful
55	F	COPD with pneumothorax	Ballooning	0.5	NIL	3 days	Localized with balloon	Persistent leak in underwater drainage system	Successful
62	M	COPD with pneumothorax	Ballooning	1	NIL	4 days	Do	Persistent leak in under water drainage system	Successful
32	M	ILD with pneumothorax	Ballooning	0.5	NIL	4 days	Do	Persistent leak in under water drainage system	Successful
25	M	Tubercular pyopneumothorax	Ballooning	1	NIL	14 days	Do	Persistent leak in underwater drainage system	Successful

COPD-Chronic obstructive pulmonary disease; NSCCL-non-small cell carcinoma lung; RTA-Road traffic accident

drainage system. All of the patients were followed-up for 6 months and are discussed in the Results section.

RESULTS

In our series of 9 cases of various indications as discussed in Table 1, 3 patients were suffering from non-small cell carcinoma lung, 2 were post-RTA (road traffic accident) resection, 2 had COPD and one each had interstitial lung disease (ILD) and tubercular pyo-pneumothorax. The patient's age ranged between 25 and 70 years. Seven were males and 2 females. Among 5 postsurgical patients, the fistula was visible at the stump site, we succeeded in all of them except one where the size of the fistulous opening was >8 mm, and this is the case where we used the maximum amount of glue (ie, 1.5 mL), and a recurrence occurred in this case after 7 days. In one case where the BPF was secondary to tubercular pyo-pneumothorax and not responding to conservative therapy, we followed the same technique and the leak reduced and it took us 14 days to remove the intercostal drainage tube. Two patients of COPD and one with ILD also had a favorable outcome. Overall, out of 9 cases, we succeeded in 8 patients and failed in one, that is, a response rate of 88.88%.

DISCUSSION

Despite the advances in technology, BPF is still a management dilemma and often fatal.^[2] The incidence has been reported from 1.5% to 28% after pulmonary resection.^[6-9]

The management guidelines not being clear, there remains an option between surgical correction and endobronchial interventions. The success rate of surgical closure of BPF has been reported between 88% and 95%^[10,11] but is associated with the risk of open thoracotomy. The reported morbidity has been as low as 0%.

Surgical closure includes chronic open drainage, direct stump closure with intercostal muscle reinforcement, omental flap, trans-sternal bronchial closure, and thoracoplasty with or without extrathoracic chest wall muscle transposition. Since the introduction of video-assisted thoracoscopy, this technique has also been used to treat BPF.

Thoracic surgeons are using intercostal muscle flap as prophylaxis on the stump, especially in postradiation surgical procedures.

Flexible bronchoscopy has been gaining acceptance as a diagnostic and therapeutic modality in patients with BPF.^[4] It allows for proper evaluation of the stump, localization of the fistula, as well as to exclude tuberculosis or other infectious etiologies and if possible, allows the introduction of sealants into the fistula.^[12]

The advantages of bronchoscopic intervention in the form of glue therapy include low costs, less discomfort, lesser time, and can be done on an outpatient basis. There are no controlled studies comparing the different sealants or comparing surgical and endoscopic therapy. In general, the endoscopic procedure is preferred in high-risk surgical candidates to avoid the risk of anesthesia and surgery.^[4] In our series all the patients were either high-risk candidates or refused to undergo major surgery.

Hartmann and Rausch^[13] and Ratliff *et al*^[14] reported the first successful endobronchial management of BPF using tissue glue and a lead shot, respectively. Since then, many reports using different devices have appeared.^[4] We have used the cyanoacrylate glue as it is easily available, cost-effective safe and we have not experienced any side effects in this series. Migration of glue or spillage of glue into the channel of bronchoscope or on to the bronchoscope has been

experienced in a series 127 cases where we have used glue in bronchoscopic management of hemoptysis and has been sent for publication in lung India. In one case, a postglue therapy patient started having breathlessness with wheeze, which was sudden in onset. Bronchoscopy was done and glue mixed with blood was localized in the trachea and was removed with foreign body removal forceps and the patient got relieved immediately. In another case, the glue spilled into the bronchoscopic channel and was removed as cast after cleaning with acetone. Glue seals by acting as a plug, and the cyanoacrylate glues polymerize into solid material on contact with body fluids or tissue.^[15,16] It has an antibacterial effect as well and induces an inflammatory response that leads to fibrosis and mucosal proliferation, leading to sealing of fistulas.

BPF size appears to be an important factor in predicting outcome the procedure. BPFs > 8 mm are not suitable for endoscopic management, whereas those that are 1–3 mm in size have the highest success rate.^[4] Scappaticci *et al.*^[17] have reported an 83% success rate among 12 cases of postresection BPF with endoscopic application of tissue glue adhesive (methyl-2-cyanoacrylate). Two of their patients who failed had fistulas larger than 5 mm.

In our study, a success rate of 88.88% corresponds to that reported by Scappaticci *et al.*^[17] One failed patient had a fistula size of 8 mm. Overall, we did not experience any complication with the use of the glue. In another case of pyopneumothorax secondary to tuberculosis, the leak gradually closed and it took us 14 days to remove the ICD.

The value of bronchoscopic sealing of bronchopleural fistulas has been studied retrospectively by Hollaus *et al.*^[18] The procedure appears to be an efficient alternative, especially when surgical intervention cannot be done because of the physical condition of the patient.

In our opinion, it is a worth trying option for this unsavory situation as there are no clear cut guidelines to treat this challenging problem. We could remove the ICD on an average in 2–4 days. No complications were observed in a follow-up of 6 months. Closure of the BPF with the glue is a simple, safe, and effective procedure. The effectiveness of glue in the closure of BPF has been well documented^[17,18] and further confirmed in our group of patients. We believe that bronchoscopy and instillation of glue should be the first-line of management in patients with BPF. This

technique can be used for both stable and critically ill patients reducing morbidity and costs as compared to open surgical procedures.

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