



A novel treatment for bronchopleural fistula after pulmonary resection by interventional technique

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Response to: Fruchter O. Innovating customized stents for the treatment of bronchopleural fistula. *J Thorac Dis* 2019;11:1097-9.

Oki M, Seki Y. A customized, covered metallic stent to repair a postoperative bronchopleural fistula: a promising endobronchial approach. *J Thorac Dis* 2019;11:1088-90.

Harris K. Customized airway stenting for bronchopleural fistula after pulmonary resection by interventional technique: single-center study of 148 consecutive patients. *J Thorac Dis* 2019;11:S1274-6.

Cusumano G, Alifano M, Lococo F. Endoscopic and surgical treatment for bronchopleural fistula after major lung resection: an enduring challenge. *J Thorac Dis* 2019;11:S1351-6.

Fiorelli A, Ferrara V, Bove M, *et al.* Tailored airway stent: the new frontiers of the endoscopic treatment of broncho-pleural fistula. *J Thorac Dis* 2019;11:S1339-41.

Ghosh S, Burks AC, Akulian JA. Customizable airway stents—personalized medicine reaches the airways. *J Thorac Dis* 2019;11:S1129-31.

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We greatly appreciate the insightful comments by Dr. Fruchter (1); Dr. Oki and Dr. Seki (2); Dr. Harris (3); Dr. Cusumano *et al.* (4); Dr. Fiorelli and colleagues (5); and Dr. Ghosh *et al.* (6) with regard to our published article titled “Customized airway stenting for bronchopleural fistula after pulmonary resection by interventional technique: single-center study of 148 consecutive patients” (7). In addition, we are grateful for the opportunity presented by Dr. Shuangjiang Li and Dr. Teresa Lin, the Section Editors of the *Journal of Thoracic Disease*, to write this correspondence and respond to the issues raised via editorials on our work.

All the editorials indicate that stent placement and removal should be performed using flexible or rigid bronchoscopes (1-6). However, we believe that stent placement and removal with bronchoscopes or via fluoroscopy are also associated with certain advantages and disadvantages. In theory, compared with the procedure involving bronchoscopes under general anesthesia, patients in the awake state, under conscious sedation, or under airway mucosal anesthesia under fluoroscopy exhibit a

shorter operation time, more accurate stent placement, no need for general anesthesia, and less strict requirement for body condition. Following stent placement, bronchoscopes enable direct observation of the airway. Our interventional department is independent with separate wards and outpatient clinics. A substantial amount of clinical work has proved that the insertion and removal of stents for bronchopleural fistula are safe under fluoroscopy (8-10). Nevertheless, these procedures require an experienced interventional radiologist who can perform airway stent placement. Patients should undergo bronchoscope examination after stent implantation to observe whether the stent is blocked by sputum, to assess for the proliferation of granulation tissue, and to ascertain the occurrence of stent fracture. Accordingly, in those cases, airway lavage, sputum aspiration, or burning/freezing of granulation tissue proliferation can be performed via bronchoscopy. Thus, the removal and implantation of the stent with the perfect combination of fluoroscopy and bronchoscopy could offer a safe intervention.

As the tracheal and bronchial diameter markedly vary and fistula location differs, the use of individualized airway stents can improve the closure rate of the fistula. In China, the individualized airway stent procedure only requires 3–5 days without any additional cost. In fact, our customized airway stents only cost ¥3,000–5,000, which is lower than the silicone stents introduced in China in 2014 that cost approximately ¥12,000 per stent.

In the treatment of bronchopleural fistula, most studies primarily focus on whether the fistula can be successfully occluded or closed, and the treatment of the residual cavity is neglected in these cases. Our technique for bronchopleural fistula treatment involves the temporary closure of the residual cavity by using an airway stent, followed by the reduction or closure of the residual cavity via continuous negative pressure aspiration. Stent removal was considered in cases where the patient was cured; the stent was damaged (degradation of components due to wear and tear as a result of respiration- and heart beat-induced movements); or severe proliferation of granulation tissue occurred that compromised the patient's breathing. Complete fistula closure is only a primary aim in the treatment of bronchopleural fistula, and healing of the thoracic cavity, extraction of the drainage tube, and successful removal of the stent indicate complete cure. In the present study, although some patients still had a residual cavity after stent removal and required an indwelling drainage tube, the quality of life of the patients had improved and the survival duration was prolonged due to the large reduction in the residual cavity size. Thus, patients really benefit from our treatment. At present, the success rate of fistula closure is satisfactory. For the treatment of bronchopleural fistula, the clinical bottleneck actually involves the promotion of healing of the pus cavity, shortening of the healing time, and improving the healing rate, which is also a focus of our future research.

Dr. Fiorelli and colleagues used a conical stent to block the bronchopleural fistula; although we consider this a suitable method of treatment, only a few such cases have been reported. In theory, these airway stents easily migrate due to coughing and breathing movements of patients, particularly as the lower tracheal segment and left and right main bronchus are usually thicker in the proximal direction and thinner in the distal direction, and because the stents are covered airway stents. However, our study showed that the stent migration rate was actually very low (1.35%, 2/148).

Furthermore, Dr. Fiorelli *et al.* and Dr. Ghosh *et al.* highlighted the potential of airway 3D printing technology,

which could help produce more anatomically individualized airway stents to improve the success rate of treatment. Unfortunately, to our knowledge, there are no reports on the clinical application of 3D printed airway stents in the treatment of bronchopleural fistula.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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