Prevention and management of postoperative air leaks

Bryan M. Burt, Joseph B. Shrager

Division of Thoracic Surgery, Stanford University School of Medicine, Stanford, USA

Correspondence to: Joseph B. Shrager, MD, Professor of Cardiothoracic Surgery, Chief. Division of Thoracic Surgery, Stanford University School of Medicine, Stanford Hospitals and Clinics, 300 Pasteur Drive, Falk Building CV-207, Stanford, CA 94305, USA. Email: shrager@stanford.org.

Submitted Nov 11, 2013. Accepted for publication Feb 27, 2014.
doi: 10.3978/j.issn.2225-319X.2014.03.03
Scan to your mobile device or view this article at: http://www.annalscts.com/article/view/3590/4466

Introduction

A contemporary, practical definition of prolonged air leak (PAL) is an air leak that lasts beyond postoperative day 5. This is consistent with the definition used in the Society of Thoracic Surgeons database and represents a leak whose duration exceeds the average length of stay (LOS) for lobectomy. The reported incidence of PAL ranges from 8% to 26% (1), but the definition of PAL has varied amongst reports. PAL increases the LOS, increases hospital costs, and is associated with elevated rates of empyema and other complications. The most consistently reported risk factors for PAL include poor pulmonary function, use of steroids, performance of an upper lobectomy, presence of a pneumothorax coinciding with an air leak, and the presence of pleural adhesions (1,2). With regard to sublobar resection, although it has yet to be studied scientifically, we believe that segmentectomy may have a higher risk of PAL compared to wedge resection due to the increased thickness of some intersegmental planes and the more extensive dissection involved.

Safeguards and pitfalls

Intraoperative prevention of air leaks

Though less often a problem after sublobar resection compared with lobectomy, attaining pleural apposition without having to resort to high levels of suction appears to be an effective strategy for preventing PALs. There are several techniques that are commonly used to minimize residual space. Mobilization of all intrapleural adhesions and division of the inferior pulmonary ligament is often practiced and likely helpful. Creation of an apical pleural tent at the time of upper lobectomy is a proven technique for decreasing PAL (3). Creation of pneumoperitoneum at the time of lower lobe resection has also been shown to decrease PAL, time of chest tube drainage, and LOS, although not without potential complications (4). Transient diaphragmatic paralysis via injection of the phrenic nerve with a local anesthetic has been described and may serve a similar purpose.

The use of sealants and buttressing material in pulmonary resection has been recently and comprehensively reviewed (5). Whereas synthetic sealants more reliably decrease the occurrence, magnitude, and duration of air leak than do fibrin sealants, this does not translate consistently into a substantial reduction in the duration of chest tube drainage or hospital stay. Similarly, routine use of staple-line buttressing has shown variable results. For surgery in the setting of severe emphysema (e.g., LVRS), randomized data has suggested that buttressing is effective, and one study also suggests that sealants may in fact be useful in patients with severe emphysema (6). Other often practiced, but less studied, techniques for intraoperative prevention of air leak include minimizing dissection within the fissure, minimizing inspiratory pressures when re-inflating the lung, careful attention to avoid overlapping parenchymal staple lines, and closing the surgical stapler slowly in thick tissues. Our opinion is that attention to these intraoperative details may be at least as effective as the commercially available approaches.

Postoperative chest tube management

The balance of evidence from randomized trials addressing water seal or reduced suction algorithms suggest that some version of reduced or part-time suction likely decreases the duration of air leak after pulmonary resection in most

patients (1). Although high level evidence is not available specifically for patients with severe emphysema, expert consensus and extensive clinical experience (in LVRS) suggest that patients with an FEV_1 <40% predicted are optimally treated with water seal in the absence of a large, symptomatic, or growing pneumothorax; progressive subcutaneous emphysema; or clinical deterioration. The traditional use of –20 cm water of suction is counterproductive in these patients. For patients without severe emphysema, available evidence suggest that either a lower amount of suction (7) or preferably water seal are reasonable, with the same contraindications, in patients with a less than large or symptomatic air leak (1).

Non-invasive management of prolonged air leak (PAL)

It is rare that aggressive re-interventions are required to treat PALs. The treatment strategy of watchful waiting is largely successful. Approximately 95% of PALs that permit waterseal will resolve within a few weeks of operation with chest tube drainage alone, with only rare development of empyema (1). For patients with no more than a small, stable, and asymptomatic pneumothorax on water seal, PALs can be managed in the outpatient setting using a one-way valve attached to the drain. If it is necessary to differentiate air leak from residual space evacuation, the patients can be admitted for a "provocative clamping" trial, and the majority of these patients will be able to safely have their chest tubes removed.

If a period of watchful waiting is unsuccessful in treating a PAL, or if water seal is not tolerated due to a larger leak, one must consider active interventions to mechanically seal the site of the leak. Most of these options are supported by expert consensus with variable amounts of published data. If the residual lung is fully expanded, chemical pleurodesis with instillation via the thoracostomy tube of tetracycline, doxycycline, or talc can promote pleural symphysis and leak closure. Autologous blood patch is another simple and often effective treatment, although some reports suggest an associated increased risk of intrathoracic infection.

Invasive management of prolonged air leak (PAL)

Invasive procedures are indicated to treat PALs if more conservative measures fail. Pneumoperitoneum instilled through a transabdominal catheter has been reported to be effective in some cases. Unidirectional endobronchial valves, originally studied for treatment of emphysema, have emerged as a useful intervention for some patients with PAL (8). Although data are currently limited, these devices have received Humanitarian Device Exemption approval from the Federal Drug Administration for this purpose.

Surgical re-exploration is rarely needed but must be considered when other approaches have failed. The choice of operation depends upon multiple factors. Bronchoscopy should be done to rule out a bronchial rather than a parenchymal fistula. If the residual lung is relatively normal, the leak can be re-stapled or oversewn with good results. Decortication of surrounding lung may be required to facilitate full lung expansion. Parietal pleurectomy or mechanical pleurodesis can be added when pleural apposition can be achieved. If a residual space is present, that space should be obliterated with either muscle or omental transposition. Following sublobar resection, completion lobectomy may be necessary on rare occasions. Thoracoplasty or the creation of an open window can be considered under extreme circumstances.

Comments

A variety of options are available to prevent and manage PALs. Intraoperative technical details are likely important in reducing their incidence. Pleural tents and pneumoperitoneum are helpful when residual spaces are likely; commercial buttresses and sealants have shown mixed results outside of severe emphysema and are expensive. Optimal postoperative management of chest tubes appears to include less than the traditional –20 cm H_2O of suction in most patients. Non-invasive approaches to resolve PALs are almost always effective, but when required, operative intervention is largely successful.

Acknowledgements

Disclosure: The authors declare no conflict of interest.

References

1. Singhal S, Ferraris VA, Bridges CR, et al. Management of alveolar air leaks after pulmonary resection. Ann Thorac Surg 2010;89:1327-35.
2. Cerfolio RJ, Bass C, Katholi CR. Prospective randomized trial compares suction versus water seal for air leaks. Ann Thorac Surg 2001;71:1613-7.
3. Brunelli A, Al Refai M, Monteverde M, et al. Pleural tent after upper lobectomy: a randomized study of efficacy and

duration of effect. Ann Thorac Surg 2002;74:1958-62.
4. Rocco G. Intraoperative measures for preventing residual air spaces. Thorac Surg Clin 2010;20:371-5.
5. Belda-Sanchís J, Serra-Mitjans M, Iglesias Sentis M, et al. Surgical sealant for preventing air leaks after pulmonary resections in patients with lung cancer. Cochrane Database Syst Rev 2010;(1):CD003051.
6. Merritt RE, Singhal S, Shrager JB. Evidence-based suggestions for management of air leaks. Thorac Surg Clin 2010;20:435-48.
7. Brunelli A, Sabbatini A, Xiume' F, et al. Alternate suction reduces prolonged air leak after pulmonary lobectomy: a randomized comparison versus water seal. Ann Thorac Surg 2005;80:1052-5.
8. Kovitz KL, French KD. Endobronchial valve placement and balloon occlusion for persistent air leak: procedure overview and new current procedural terminology codes for 2013. Chest 2013;144:661-5.

Cite this article as: Burt BM, Shrager JB. Prevention and management of postoperative air leaks. Ann Cardiothorac Surg 2014;3(2):216-218. doi: 10.3978/j.issn.2225-319X.2014.03.03

