Novel treatment (new drug/intervention; established drug/procedure in new situation)

The use of a portable digital thoracic suction Thopaz drainage system for the management of a persistent spontaneous secondary pneumothorax in a patient with underlying interstitial lung disease

William S A Jenkins,¹ David P Hall,¹ Kev Dhaliwal,² Adam T Hill,² Nik Hirani²

¹Department of Medicine, Royal Infirmary of Edinburgh, Edinburgh, UK

²Department of Respiratory Medicine, Royal Infirmary of Edinburgh, Edinburgh, UK

Correspondence to Dr William Stephen Arthur Jenkins, williamjenkins@doctors.net.uk

Summary

We present the case of a 68-year-old woman who presented *in extremis* with a secondary pneumothorax with a past history of severe idiopathic pulmonary fibrosis. Following insertion of a 32F intercostal drain, she developed a persistent broncho-pleural fistula and became dependent on negative-pressure wall-mounted suction to prevent respiratory compromise. She declined definitive surgical intervention and was therefore managed conservatively. After adhering to the wall-mounted suction method for 49 days, we obtained for use a portable digital thoracic drainage system previously used only in the cardiothoracic postoperative patient. This electronically delivered, negative-pressure drainage system induced radiographic improvement within 24 h, and allowed the patient to mobilise for the first time since admission. The patient was discharged home with the Thopaz drain in situ 8 weeks after placing it, and the drain was removed successfully with a resolved pneumothorax 20 weeks after her initial presentation.

BACKGROUND

This study describes a novel solution to the problem of persistent pneumothorax in end-stage lung disease, which has previously been applied only to surgical postoperative patients.

CASE PRESENTATION

Our patient is a 68-year-old woman with a past history of idiopathic pulmonary fibrosis, breast cancer treated with mastectomy and radiotherapy, chronic obstructive pulmonary disease, rheumatoid arthritis and previous tuberculosis. Prior to admission, she was able to walk short distances to the shops, and was limited functionally by joint pain rather than dyspnoea. She lived independently at home with her husband. Spirometry 6 months prior to admission demonstrated a forced expiratory volume in one second of 1.4 l/s (85% predicted), forced vital capacity of 1.75 l (87% predicted) and a carbon monoxide transfer factor of 2.57 (41% predicted) (figure 1).

She was admitted with a 24 h history of increasing shortness of breath and right-sided pleuritic chest pain. On presentation to the emergency department she was in significant respiratory distress. An initial arterial blood gas on high-flow oxygen (FiO₂ 90%) demonstrated a PaO₂ of 5.7 kPa and a PaCO₂ of 7.9 kPa. A chest radiograph confirmed a right-sided pneumothorax with evidence of mediastinal shift (figure 2). A right-sided 14F Seldinger intercostal drain was inserted in the emergency department, with some resolution in her symptoms. Despite this, her high oxygen demand persisted and she was commenced on intravenous antibiotics for coexistent community-acquired pneumonia and was transferred to the medical high-dependency unit.

A repeat chest radiograph failed to show re-expansion of the underlying lung (figure 3), and due to a high oxygen requirement, negative-pressure, wall-mounted suction was applied at a pressure of -10 cm H₂O on day 2 of her admission. After 2 days on suction, her arterial oxygen saturation still fell to 60–70% (FiO₂ 32%) on disconnecting the suction. A larger 28F intercostal drain was therefore inserted on day 4 of her admission and the level of suction was increased to -20 cm H₂O.

Although this measure encouraged some limited lung re-expansion, she had a continued broncho-plural fistula. The cardiothoracic surgical team reviewed her and offered the option of definitive surgery with video-assisted thoracoscopic pleuridesis, which she declined as she had an aversion

Figure 1 High-resolution computed tomography image taken 1 year prior to admission, showing extensive, established pulmonary fibrosis.

Figure 2 Chest radiograph on admission, showing a pneumothorax of the right lung with significant interstitial shadowing of the left lung.

to surgical operations. Her condition was complicated further by the development of an empyema on day 15, which was managed with intravenous tazobactam/piperacillin and vancomycin. With no resolution in her underlying pneumothorax by day 29, a second 32F drain was inserted at the right apex, although this had no effect. Her initial 28F drain was removed on day 31 following a second episode of sepsis, which was treated with meropenem (figure 4).

Serial chest radiographs showed tethering of the mid-section of the lung to the chest wall with persistent basal and apical pneumothoraces. The patient remained dependent upon the wall-based suction system, de-saturating significantly upon cessation of suction, and therefore our patient remained adherent to the hospital wall with a significant decline on both her functional status and mood.

TREATMENT

The possibility was raised of using a portable suction drainage system, an intervention which is used in the postoperative thoracic setting. A Thopaz digital thoracic drainage system was obtained on loan from Medela UK Ltd (Manchester, UK) on day 46 of admission. This measured the air leak as 3 l/min, and the patient was placed on a constant 1.5 kPa of suction. The following day a chest radiograph showed signs of improvement.

Figure 3 Chest radiograph following a 12F Seldinger intercostal drain insertion on admission, with partial re-expansion of the right lung.

Figure 4 Day 31 following 32F intercostal drain insertion, with a persistent pneumothorax and tethering of the mid-portion and basal portion of the right lung.

The portable nature of the drain allowed her to mobilise with the physiotherapists for the first time since her admission, while serial chest radiographs continued to show a gradual resolution in her pneumothorax. A CT scan of the chest performed on day 52 demonstrated multiple cysts and bullae around the lung edge, and a persistent non-loculated anterior right pneumothorax (figure 5). With an unrepaired bronchopleural fistula, it was thought possible that the lung would fail indefinitely to re-expand, and so her discharge was planned on the presumption that she may have a permanent need for the portable drain system. Despite this, on day 96 of her admission, we were able to reduce the flow rate on the digital suction drainage system to zero. A chest radiograph confirmed complete re-expansion of the lung. The drainage system was switched to a gravity-only setting, and because of the inadvisability of causing any trauma to the underlying lung, the patient was discharged home on day 116 of her admission with the chest drain in situ. She was supported at home by a thrice-daily package of care, domiciliary oxygen therapy and respiratory specialist nurse home visits.

Figure 5 High-resolution computed tomography scan on day 52 following intercostal drain insertion. There is progression of the pulmonary fibrosis and a small anterior right-sided pneumothorax with the intercostal drain positioned medially against the mediastinal surface. It is clear from an assessment of the lung edge that there are multiple bulla/cyst just on the lung edge and presumably this has been the predisposing cause of the pneumothorax.

Figure 6 High-resolution computed tomography scan on day 137 following intercostal drain insertion. Full resolution of the right pneumothorax with the encapsulated chest drain tip.

OUTCOME AND FOLLOW-UP

Four weeks following discharge, the patient was re-admitted as she had become generally unwell. With no indicators of infection, she was not treated with antimicrobials and transferred to the respiratory unit for observation. The lung remained re-expanded on gravity drainage and a repeat CT scan confirmed resolution of the pneumothorax with a thick-walled cavity surrounding the chest drain (figure 6). The drain was clamped for 24 h and then removed on the following day without complications, 139 days after her initial presentation. The wound was left patent and packed with an alginate rope and an adhesive dressing, and she was discharged home after a short course of physiotherapy and follow-up in the respiratory clinic. She remains well in the community, supported by a package of care.

DISCUSSION

This is the first documented case of a portable thoracic suction drainage system used in the management of a spontaneous pneumothorax. Applying suction to a tube thoracostomy is usually considered in the event of a persistent air leak. The rationale supporting the role of suction is that air is withdrawn from the pleural cavity at a rate that exceeds the outflow of air through the visceral pleural leak, subsequently apposing the pleural layers and promoting healing. The British Thoracic Society 2010 guidelines state that suction should not be routinely deployed in the management of a pneumothorax,¹ while the American College of Chest Physicians suggest that suction can be used via a water-seal device should the lung fail to re-expand quickly.² There is little clinical evidence available for the role of suction in medical patients (as a group distinctly different from postoperative thoracic patients). The two largest studies represent a total of 124 patients, and fail to see an advantage of the use of suction drainage over traditional systems.^{3 4} In our patient's case, she had become dependent upon the negative pressure-

induced pulmonary re-expansion that wall-mounted suction provided, and desaturated significantly upon cessation of this. A traditional ambulatory chest drainage system, such as a one-way mechanical valve, was therefore not suitable.

The benefit of digital air leak assessment and regulated suction postoperatively following thoracic intervention is well established.^{5 6} The Thopaz drain is marketed as the smallest digital thoracic drainage system available. Devices such as these provide 'regulated' suction, in that the suction source is able to vary the flow provided to achieve a predetermined intrapleural pressure, as set by the physician (eg, -20 cm H_2O). This has advantages over the inconsistent 'unregulated' suction provided by wall-mounted units, which cause large fluctuations in intrapleural pressures. They have the additional benefit of preserving patient mobility and dignity.

This is a so far unreported application of an advanced technology that, because of its positive impacts on reduced length of hospital stay following thoracic surgical intervention, may become increasingly available to respiratory physicians, and has the potential to significantly reduce the morbidity of those patients with persistent air leaks who do not qualify or opt out of surgical management.

Learning points

- Even with a pneumothorax lasting for over 3 months and multiple comorbidities, it is possible for such patients to eventually be discharged to their home environment, and we caution against dismissing the treatment of such patients as a futile exercise.

Competing interests None.

Patient consent Obtained.

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