Case Report

Transtracheal Oxygen Therapy and Bronchial Toileting using Minitracheostomy in Patients with Advanced Respiratory Failure

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Abstract

Maintaining the high oxygen demands and bronchial hygiene of critically ill patients with advanced respiratory failure is often difficult. We describe three such cases with advanced respiratory failure where a modification of conventional transtracheal oxygenation was used successfully. This method provided the added advantage of being more cost-effective and helping in easy bronchial toileting. **[Indian J Chest Dis Allied Sci 2016;58:45-47]**

Key words: Transtracheal oxygen, Minitracheostomy, Bronchial toilet.

Introduction

Maintaining the high oxygen demands and bronchial hygiene of critically ill patients with advanced respiratory failure is often difficult. We describe three such cases with advanced respiratory failure where a modification of conventional transtracheal oxygenation was used successfully.

Case Reports

Case 1. A 83-year-old male smoker, diagnosed to have extensive small-cell lung carcinoma, presented with hypoxaemic respiratory failure. On evaluation, he was in respiratory distress and blood gas evaluation showed a arterial oxygen tension (PaO_2) 28 mmHg. Despite being given 60% oxygen (10L / min) by Venturi mask, oxygen saturation while breathing room air was around 80%. Computed tomography (CT) of the chest showed a large mass lesion in the right lower lobe with extensive lymphangitis with bilateral secondaries. He and his family did not give consent for intubation, but at the same time were willing to try chemotherapy. Because his oxygen requirement was high and the family wanted to take him home after chemotherapy, we decided to give transtracheal oxygen to him as a means to decrease the oxygen requirement to a level where he could be managed at home. A minitracheostomy (Mini-Trach II; Portex, Keene, NH), via the cricothyroid membrane was performed under local anaesthesia as a stopgap measure and chemotherapy was administered simultaneously. After the procedure, his oxygen requirement reduced and we were able to maintain 96%-98% saturation on 3L / min of oxygen through the minitracheostomy port. The patient showed considerable response to chemotherapy and was weaned off supplemental oxygen over the next one month and the minitracheostomy port was removed. The patient went on to receive five more cycles of chemotherapy. By performing a minitracheostomy and using the conduit as a transtracheal oxygen delivery device, we were able to decrease the oxygen requirement in this patient till he could be stabilised on chemotherapy.

Case 2. A 64-year-old woman with chronic remodelled bronchial asthma and bronchiectasis presented with worsening hypercapnic respiratory failure. She was on supplemental oxygen through nasal prongs for the past 10 years and had been prescribed domiciliary non-invasive ventilation (NIV) for hypercapnia for the past three years. Even when stable, the patient had an oxygen saturation of 82% on room air with a PaO_2 of 40mmHg and arterial carbon dioxide tension ($PaCO_2$) of 68mmHg, despite being on 60% oxygen (10L / min) administered through a Venturi mask and NIV. The patient would desaturate frequently due to profuse secretions and advanced disease. She was admitted in our hospital for the preceding three months and had to be intubated and mechanically ventilated twice because of the same. As an attempt to bring down her oxygen requirement and to aid in bronchial toileting, a minitracheostomy was performed. After the procedure, she was able to maintain a saturation of 95% on 3L / min of oxygen. The minitracheostomy port also aided in regular clearing of the profuse purulent secretions. Over the next two weeks the patient stabilised and was discharged with the minitracheostomy *in situ* and was

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advised regular suctioning through the conduit. Since then the device has been changed twice at two monthly intervals. The oxygen requirement has remained stable. The patient is comfortable with the tube *in situ* and has not reported any complaints of pain, dysphonia, dysphagia, tube displacement, tube blockage, and so on.

Case 3. A 72-year-old female, active smoker and a known case of chronic obstructive pulmonary disease (COPD), sleep disordered breathing, and severe pulmonary hypertension presented with worsening hypoaxemic respiratory failure. In view of severe hypoxaemia (PaO_2 of 34mmHg on room air) and respiratory distress, the patient was intubated and mechanically ventilated. She was mechanically ventilated for six days and was extubated on NIV support. The patient had severe pulmonary hypertension (pulmonary artery systolic pressure 70mmHg on two-dimensional echocardiography) and was started on bosentan and sildenafil to control the same. With this and appropriate bronchodilator therapy, the pulmonary artery pressures decreased to 54mmHg over two weeks, but she continued to have high oxygen requirement of about 8-10 L/min on Venturi mask, and this was a deterrent to discharge from the hospital. As an attempt to bring down her oxygen requirement, a minitracheostomy was performed and the conduit used as a transtracheal oxygen delivery device. After the procedure, the patient could be managed on 5L/min of oxygen and was subsequently discharged on transtracheal oxygen and continuous positive airway pressure support. Follow-up visit after two weeks shows that she is comfortable with the minitracheostomy *in situ* and her oxygen requirement is now easily met with a conventional oxygen concentrator.

Discussion

Despite the fact that long-term oxygen therapy (LTOT) has been shown to reduce mortality in patients with COPD,[1] delivery of LTOT through a simple efficient device called a transtracheal catheter appears to be underutilised. Use of transtracheal oxygen therapy helps in reduction of oxygen flow rates by 50% at rest and by 30% during exercise in most patients compared to continuous oxygen delivery through nasal cannula.[2] The method is cosmetically more acceptable, eliminates nasal irritation by prongs, and enhances compliance. Further, transtracheal oxygen therapy decreases the dead space by by-passing the upper airways, decreasing dead space, and acting as a reservoir for oxygen. Inspiratory minute ventilation and work of breathing decrease with transtracheal oxygen therapy, with resulting reduction of dyspnoea. Diaphragmatic pressure-tension time indices improve with transtracheal oxygen therapy, improving exercise tolerance.[3]

Retained tracheobronchial secretions complicate the recovery of many patients and may lead to complications, such as atelectasis, pneumonia, and respiratory failure. Conventional methods of dealing with retained secretions include hydration, humidified oxygen, early mobilisation, coughing, incentive spirometry, chest physiotherapy, and, rarely, blind naso-tracheal suctioning. These measures may fail and occasionally lead to the need for intubation and ventilation. Minitracheostomy using the Seldinger technique is a minimally invasive method to facilitate endotracheal suctioning and clear secretions.[4] Patients suffering from advanced COPD are known to have difficulty in expectoration and oxygenation with conventional methods, such as nasal cannula, masks and venturies. They have significant hypoxia even during mild activity. They also have repeated episodes of exacerbation due to retention of secretions, leading to repeated emergency room visits and hospitalisations leading to poor quality of life and limited survival. However, use of a newer modality, like transtracheal oxygen therapy and bronchial toilet was found to be useful in improving oxygenation and maintenance of bronchial hygiene in the patients. This has resulted in significant improvement in cough, dyspnoea and exacerbations resulting in the reduction of hospitalisations and overall improvement in the quality of life. It is to be used on the long-term (life-long) basis, however, its safety and efficacy needs to be studied on a long-term follow-up. It is easy to use, inexpensive and patient-friendly.

The methods conventionally used for transtracheal oxygen therapy, such as the Spofford Christopher Oxygen Optimising Program (SCOOP) and the Heimlich Micro-Trach system are not easily available in our setting and are more expensive than the more easily available minitracheostomy sets. The spares and consumables (including accessories) used in this procedure are inexpensive and easily available. Each component is very patient-friendly and the cost involved is relatively low. It is useful in patients who cannot be offered any other modality as remedy or support. The initial cost of the minitracheostomy tube set is approximately ₹4500/-. During subsequent change every two months, the cost (recurrent expenditure) of the tube is approximately ₹2000/-.

Also, minitracheostomy is a one-time procedure, whereas transtracheal oxygen therapy systems typically require three to four sittings. Transtracheal oxygen therapy using the conventional methods (such as SCOOP) can not be prescribed to sick, unstable patients with high oxygen demand.[5] Surgical skills required for minitracheostomy are lucid and easily learnt. In all our patients, the procedure was conducted in the intensive care unit (ICU), through the cricothyroid membrane under local anesthaesia without any procedural complications. The added advantage of using the minitracheostomy as a transtracheal oxygen therapy device is in secretion

clearance, which can be taught to the patients and attendants and can be easily carried out at home. Because the lumen of these tubes is bigger than that of the classical transtracheal oxygen therapy tubes, problems, such as mucus impaction should also be less. We have used this method in three patients, as described earlier with satisfactory results. We wish to highlight here that transtracheal oxygen therapy is a simple but unfortunately underutilised technique for delivering LTOT, especially in patients with advanced disease and high oxygen requirement who cannot be managed with conventional means. Using the minitracheostomy tube as a transtracheal oxygen therapy device not only decreases the oxygen requirement but also cuts cost and aids in easy bronchial toileting.

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