

PERSPECTIVE

# Long-Term Oxygen Therapy: Whatever Happened to Transtracheal Oxygen?

Michael David Schwartz<sup>1</sup> (schwartzm@njhealth.org) and Barry Make<sup>2</sup> (makeb@njhealth.org)

<sup>1</sup>Intensive Care Unit, Rose Medical Center/National Jewish Health; Associate Clinical Professor of Medicine, University of Colorado School of Medicine, Denver, Colorado

<sup>2</sup>Co-Director, COPD Program, National Jewish Health; Professor of Medicine, University of Colorado School of Medicine, Denver, Colorado

## INTRODUCTION

Despite the fact that long-term oxygen treatment (LTOT) has been shown to reduce mortality in patients with chronic obstructive pulmonary disease (COPD) (1), delivery of LTOT via a simple, comfortable, and efficient device called a transtracheal catheter (Transtracheal Systems, Englewood, CO) appears to be uncommonly utilized. Over the past twenty years, more than 160 papers have been published attesting to the benefits of this technique of oxygen administration. Use of transtracheal oxygen therapy (TTOT) allows reduction in oxygen flow rates by 50% at rest and by 30% during exercise in most patients compared to continuous oxygen delivery via nasal cannula (2). Inspiratory minute ventilation and work of breathing decrease with TTOT, with resulting reduction of dyspnea (3, 4). Diaphragmatic pressure-tension time indices improve with TTOT, improving exercise tolerance (4).

In patients switched from nasal cannula to transtracheal oxygen therapy, oxygenation is improved, and secondary erythrocytosis resolved (2, 5). In a nonrandomized study of 165 patients,

hospitalization rates were decreased with TTOT, and mortality was improved, compared to nasal cannula oxygen (6). Moreover, transtracheal oxygen may be a more reliable means of delivering LTOT 24 hours a day compared to nasal cannula oxygen, since the catheter is not easily dislodged. Even in controlled clinical trials there is less than optimal adherence with oxygen via nasal oxygen prescribed 24 hours a day (7). Animal experiments suggest that intermittent hypoxia can lead to pulmonary hypertension but reports in humans have not provided consistent evidence for the benefits of oxygen in those with intermittent hypoxia (8–11). TTOT is also less cumbersome and less obtrusive, a major advantage for patients reluctant to be seen in public using oxygen.

More recently, advanced applications of TTOT have been used to assist with weaning from mechanical ventilation (12), high flow oxygen delivery in the setting of severe hypoxemia (13, 14), and as an alternative to continuous positive airway pressure devices in the setting of obstructive sleep apnea (15). While transtracheal catheters have historically been placed transcutaneously via a modified Seldinger technique by pulmonologists, an alternative approach to placement by general surgeons or otorhinolaryngologists called the “Fast Tract” has gained popularity in recent years, and appears to be safe, cost effective, and result in better long-term preservation of the small tracheal stoma (16).

One author’s (MS) decade of experience in a busy (but by no means unusual) pulmonary and critical care community practice has clearly demonstrated the profound benefits of TTOT in a variety of lung diseases beyond COPD, including advanced fibrotic lung disease, cor pulmonale, post tracheostomy decannulation following prolonged mechanical ventilation, and bronchiectasis, even with significant secretion control issues. The benefits of transtracheal oxygen in empowering patients and enhancing self-esteem are often enormous. Transtracheal oxygen therapy is neither a treatment in search of a disease, nor is it solely a cosmetic procedure. Although there are no published guidelines for the use of TTOT, we suggest that candidates for TTOT include patients who

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Abbreviations:

LTOT—long term oxygen therapy

TTOT—transtracheal oxygen therapy

COPD—chronic obstructive pulmonary disease

Correspondence to:

Barry Make, MD

National Jewish Medical and Research Center

1400 Jackson Street

Denver, CO 80206

phone: 303-398-1720

fax: 303-270-2249

email: makeb@njhealth.org

- meet current guidelines for long-term continuous oxygen therapy,
- are currently mobile outside the home,
- demonstrate motivation to remain active,
- adhere to oxygen therapy and TTOT care and cleaning.

In addition, TTOT is appropriate for patients who

- require higher oxygen flows and wish to remain active using lower flows via TTOT, or
- refuse to wear oxygen for cosmetic reasons or due to nasal problems.

TTOT may not be appropriate for individuals with copious secretions, and we recommend that TTOT candidates have an FEV<sub>1</sub> of approximately 500 mL or greater without significant hypercapnia.

Why is TTOT not more widely offered by the community of physicians caring for patients with chronic hypoxia? Perhaps there is a perception that TTOT programs generate a significantly increased workload for health care providers, or that complication rates are high. Pulmonary physicians, who assist in the management of many patients on LTOT, may have less experience with tracheostomies and thus less interest in TTOT. Oxygen therapy is so frequently prescribed that physicians may be not considering the importance of patient lifestyle and individual needs. The emergence and interest in the use of noninvasive ventilation may have reduced the interest in TTOT.

While TTOT clearly requires a program of patient education and ongoing support (5), such elements should be part of any pulmonary practice or hospital-based respiratory care department, particularly for patients with severe COPD receiving any form of long-term oxygen therapy. Postoperative complications of the Fast Tract procedure appear to be low, although requiring more resources due to the operative placement of the initial stent. However, the surgical placement is associated with a higher financial cost and patients should be appropriately informed about the risks of surgery. While some patients experience increased cough, this symptom generally abates as the tract matures (16).

Symptomatic mucus balls occurred in approximately 10% of patients in earlier studies of the catheter (5) and more serious adverse outcomes including death have been reported from this complication. However, in our more recent experience they appear less common, possibly due to the use of inhaled corticosteroids or the use of the surgical procedure for placement. However, there are no studies which have demonstrated that the surgical procedure reduces long-term T<sub>2</sub>O complications. Most clinicians feel that prevention of mucus balls and their management can be enhanced with an educational program stressing the importance of saline irrigations and regular catheter changes. One publication reported pneumonias in four patients with interstitial lung disease receiving oral corticosteroids (17).

Clinical experience suggests that providing care to transtracheal patients is not more difficult, but rather care is enhanced perhaps because patients with transtracheal catheters have less dyspnea, improved oxygenation and work of breathing, de-

creased hospitalization rates, and improved quality of life. In fact, two studies have shown that TTOT patients have fewer admissions for respiratory exacerbations (2, 18). In a preliminary report, the cost per admission in eighty hospitalized TTOT patients was \$3100 (in 1995 dollars) less per admission, when compared to matched controls on nasal cannula oxygen (6).

There are no obvious reasons why TTOT has not proliferated been more widely used. The Fast Tract (surgical) approach to catheter placement has a good safety record, and is well tolerated, even by patients with advanced lung disease, and does not require general anesthesia. The Centers for Medicare and Medicaid Services provides reimbursement for the procedure. However, only a limited number of centers are available with the necessary experience, training and support programs available for the placement and management of TTOT. Patients should be referred to centers experience in TTOT.

There appears to be a renewed interest in research on the possible benefits of oxygen therapy in subsets for patients with COPD. Abundant research opportunities thus exist: investigating the physiologic efficiencies created by transtracheal gas flow; assessing outcomes of higher flow and higher oxygenation on exercise, during sleep and for individuals receiving mechanical ventilation; studies TTOT in patients with hypercapnia; the use of the device in sleep-related breathing disorders (higher flows may stent open the upper airway); evaluating its impact on health related quality of life, hospitalization rates, outpatient and inpatient resource utilization, and overall mortality. We encourage the pulmonary community to reconsider TTOT as a potentially important approach to LTOT. There are thousands of patients who may benefit from it.

### *Declaration of interest*

The authors have provided consultation services to a commercial entity that has an interest in the subject of this manuscript.

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