**Transtracheal Oxygen Therapy:**

The Best-Kept Secret in Medicine?

**By John R. Goodman, BS, RRT**

Transtracheal oxygen therapy (TTOT) is the administration of oxygen directly into the trachea via a small, flexible, plastic catheter. It is intended only for patients requiring long-term, continuous oxygen therapy and is a scientifically validated alternative to oxygen delivered by nasal prongs.

Long-term oxygen therapy has been utilized to treat a variety of pulmonary conditions since the 1930s. Early work by Richards and Barach, and later Petty and Finigan suggested that oxygen therapy could significantly benefit selected COPD patients. As a result, current estimates suggest that approximately 1,000,000 patients in the United States are receiving continuous supplemental oxygen. It is estimated that there are another 750,000 patients in Western Europe on LTOT as well. In the United States, the cost of this therapy exceeds $2 to $3 billion annually. The vast majority of these patients use nasal prongs. Nasal prongs are inexpensive and simple to use, but compliance with nasal prongs is suboptimal for a variety of reasons.

Landmark studies such as the Nocturnal Oxygen Therapy Trial (NOTT) done in the 1970s clearly showed that nasal prong patients actually were willing (or able) to wear their oxygen an average of only about 18 hours per day for both voluntary and involuntary reasons. Some examples cited were nasal prongs routinely falling off during sleep, and many patients complained of discomfort of the nose and ears. Additionally, some patients will not go out in public wearing nasal prongs because of self-consciousness or embarrassment. The net result of this noncompliance is that most oxygen-dependent patients are not getting the full benefit of their therapy, and the majority of patients are not receiving oxygen as intended by their physician.

An Alternative

In 1982, in an attempt to eliminate the problems inherent in the design of nasal prongs, Henry Heimlich, MD, created the concept of delivering oxygen directly into the trachea via a small plastic tube. After successful preliminary studies in dogs, he began administering transtracheal oxygen to patients with "chronic pulmonary disease and respiratory disability." A 16-gauge Teflon IV catheter was placed between the second and third tracheal rings. There were few complications and no catheter-related deaths occurred. Reductions in flow requirements of oxygen of approximately 50% were noted. There were anecdotal reports of reduced shortness of breath and improvements in ambulation. Other investigators quickly followed with studies of their own, all essentially verifying the original findings of Heimlich.

Scientific foundations have been amply demonstrated in the medical literature with more
The most effective transtracheal program is divided into four clinical phases

**Phase I**
*Patient Orientation, Evaluation, Selection, and Preparation*

**Phase II**
The Transtracheal Procedure and Stenting

**Phase III**
Transtracheal Oxygen with an Immature Tract

**Phase IV**
Transtracheal Oxygen with a Mature Tract

than 160 articles published regarding transtracheal oxygen therapy since Heimlich’s first article in 1982. Transtracheal oxygen therapy offers many benefits that meet the specific therapeutic goals identified by the NOTT study. True 24-hour compliance, a more active lifestyle, and conservation of oxygen resources are all feasible with this technology. A well-selected TTOT candidate has a 50% to 60% reduction in resting oxygen flow rate, and a 30% decrease with activity. TTOT can be used very effectively with pulse or dose type oxygen-conserving devices, further reducing bulk oxygen consumption.

The combined physiologic and life-style benefits of transtracheal oxygen result in an improved overall quality of life for the patient, due in large part to a return to a more normal daily regimen of living.

Physiologically, transtracheal oxygenation catheters have been proven to be superior to oxygen delivered by nasal prongs, with improved compliance being a validated by-product. Safety and efficacy in appropriately selected patients, with minor and acceptable complication rates, are well documented. Studies also have documented reduced hospitalizations, reduced shortness of breath, improved exercise tolerance, and increased longevity.12-14

**More Than Just a Procedure**
Transtracheal oxygen therapy is a program of care that requires a systematic, team approach to produce the best results for the patient. A knowledgeable team consists of a physician (usually a pulmonologist), office- or hospital-based respiratory therapist or nurse, patients and their partners, and the home care therapist or nurse. Together, they provide the education, clinical support, and supplies necessary to support transtracheal patients during the four phases of the program. In this way, all of the special needs of the pulmonary patient, in addition to their oxygen requirements, will be periodically monitored for appropriateness.

The most effective transtracheal program is divided into four clinical phases:
Although only a very few physicians continue to use the modified Seldinger approach, clinicians might need to be familiar with it and its supportive program. The procedure involves making a small opening into the trachea utilizing a needle, wire guide, and tissue dilator. It is normally done as an outpatient procedure. In patients are not usually stable enough to tolerate the procedure, and, unless there are some very unusual circumstances, it should be postponed until the patient is stable enough to have the procedure performed on an outpatient basis.

The procedure should be scheduled early in the day and early in the week. With the patient sitting in an ENT-type chair and use of just local anesthesia, the neck is prepped, and a small vertical incision (1 cm) is made in the preselected site. A needle is passed through the incision and into the trachea. A wire guide is passed through the needle, and the needle is removed. A smooth tissue-type dilator is passed over the wire, and the tissues are gently stretched for about 1 minute. The dilator is removed, and a stenting device is passed over the wire guide into the trachea. The wire guide is removed, and the stent is sutured to the neck with two sutures. The patient has a chest x-ray to confirm proper position, is monitored for approximately 1 hour, and discharged home with specific instructions for tract-site care and what to do if problems arise. An appointment is made for the next week—when the stent will be removed and a functioning catheter inserted. Only a very small percentage of hospitals continue to perform the modified Seldinger technique, as there is little or no reimbursement for it, is very labor intense, and it has a higher complication rate than the Fast Tract procedure.

On the Fast Tract
This procedure was developed as an alternative to the conventional modified Seldinger approach as a result of many small tract-related glitches associated with the Seldinger approach, and initially the Fast Tract—developed by Alan Lipkin, MD, an ENT surgeon in Denver—was used to fix problematic Seldinger tracts. Over time, it became the preferred procedure. It is a surgical procedure that must be done in the operating room by a qualified surgeon. Fast Tract utilizes conscious sedation anesthesia, and an anesthesiologist must be in attendance. The procedure takes approximately 35 to 45 minutes, and the patient spends the night in the hospital.

In this procedure, the surgeon creates and elevates skin flaps, eventually exposing the anterior tracheal wall. The surgeon then tackles the skin flaps to the underlying sternothyroid muscles. This creates a permanent trabecular tract. There are a number of advantages to the Fast Tract procedure. Transtracheal oxygen can be initiated the very next day instead of in a week, as in the Seldinger technique. Also, the normal 6- to 8-week period necessary for the creation of a fully healed tract is reduced to 10 to 14 days, significantly reducing complications. Additionally, the likelihood of losing the tract is virtually eliminated. The decision regarding which of the two procedures is best for a patient depends on a number of variables. The patients and their physicians should make the final decision, but the majority of pulmonologists and sponsoring hospitals favor the Fast Tract procedure.

Phase II: The Transtracheal Procedure and Stenting
Phase II has two primary goals:
1) To create a high-quality tract that is in the tracheal midline—not through carilage and not through the cricothyroid membrane; and
2) To ensure stability and well-being of the patient on the day of the procedure and during the first few preoperative days and the rest of the week.

Phase III: Transtracheal Oxygen with an Immature Tract
The goals of phase III include:
• Initiating transtracheal oxygen;
• Avoiding or treating tract problems;
• Avoiding or treating mucus problems;
Phase IV: Transtracheal Oxygen with a Mature Tract

The goals of phase IV include:
- Assessing tract maturity;
- Customizing cleaning protocols;
- Continuing ongoing and intermittent follow-up.

Phase IV begins 6 to 8 weeks after the modified Seldinger procedure, and approximately 14 to 21 days after the Fast Tract procedure. The maturity of the transtracheal tract can now be determined to see if the tract is healed enough to permit catheter removal and reinsertion.

A tract is deemed mature when the catheter can be easily removed and reinserted by the patient. This determination is made by a clinician (preferably the surgeon who performed the procedure), first over a wire guide, and then just the catheter alone. Patients should demonstrate proficiency at catheter removal and reinsertion before being allowed to go home from this first visit of phase IV. Assessing tract maturity is much less problematic with the Fast Tract technique than it is with the modified Seldinger technique, as much more tissue is removed, and the stoma opening is quite a bit larger than the tract created by the modified Seldinger approach.

The first week of phase IV is a trial period, if for any reason difficulty is encountered with catheter removal or reinsertion, the catheter is reinserted and the patient continues phase III for an additional 1 to 2 weeks.

The patient's physician can reassess tract maturity at that time. Catheter cleaning is customized for all patients during phase IV to meet their individual clinical needs. It is rare to have even two patients clear their catheters in exactly the same way, despite the best efforts of team members to standardize cleaning regimens.

Reimbursement for transtracheal oxygen therapy has always been limited. There are well-established codes for the physician performing transtracheal procedures. There are also a selection of DRG codes that can be utilized by the hospital. CMS, on the other hand, has unfortunately determined that replacement catheters are not to be included in the monthly oxygen allowable for supplies. It would literally take an act of Congress to change the current lack of reimbursement, and no change in this situation is expected in the near future. This is probably the single most important reason why TTOT is not as widespread as early investigators expected. There is simply no financial incentive for a home oxygen company to make their oxygen-dependent patients aware that TTOT exists as an alternative. It is an understandable and defensible position.

Summary

Transtracheal oxygen, used clinically for well over 22 years, is a safe and efficacious way to deliver long-term oxygen therapy. It has clearly demonstrated and documented benefits over standard nasal prongs, including better patient compliance, oxygen conservation, and improved comfort and overall quality of life. It is also clear that reduced hospitalization and increased longevity are important by-products of transtracheal oxygen therapy. In well-selected patients TTOT is a life-changing therapy.

John R. Goodman, BS, RRT, is a respiratory care educator in Denver. For further information, contact RTEditor@ascendmedia.com.