

Nasal Cannula Oxygen: Use Before and During Intubation

Robert Glatter, MD, Richard M. Levitan, MD | April 29, 2014

Robert Glatter, MD: Welcome. I am Dr. Robert Glatter, Editorial Board Member of Medscape Emergency Medicine. We are at AAEM 2014, the American Academy of Emergency Medicine Annual Scientific Assembly. Today we will be talking about high-flow nasal cannula oxygen during preoxygenation.

With me is Dr. Richard Levitan, who is Adjunct Professor at Dartmouth Medical School in Hanover, New Hampshire, and a visiting Professor at University of Maryland School of Medicine. Dr. Levitan has extensive expertise in emergency airway management and is here to discuss this phenomenon of nasal cannula oxygenation. Welcome, Dr. Levitan.

Richard M. Levitan, MD: Thank you, Robert, for having me.

Dr. Glatter: Absolutely.

Dr. Levitan: It is good to be here.

Dr. Glatter: It has been a great meeting, and this topic certainly caught my attention because of its importance to all emergency medicine physicians and providers.

Dr. Levitan: One of the intimidating aspects of airway management is when we cannot oxygenate patients. Historically, the approach to oxygenation has been to force air and oxygen by bag valve mask through the mouth, generally with the patient in a supine position, until the patient can be intubated. What is interesting in the physiology of airway management and the anatomy of airway obstruction is that going through the nose is a far better way to oxygenate patients than through the mouth.

Dr. Glatter: Why is that? Can you describe the mechanics?

Dr. Levitan: First, all you have to do is look at the patients, and nature shows you. You and I both have seen countless people with air hunger arrive at the emergency department, whether with heart failure, bad pneumonia, or something else. We place a non-rebreather mask over the patient's face, and the first thing the patient does is rip the mask off. It is instinctive.

Moreover, 15 liters of oxygen per minute is an insufficient flow in a seriously tachypneic patient, who ends up with air hunger. The patient rips off the mask because he or she can breathe better with the mask off.

But a second phenomenon is totally underappreciated: Although we are flowing 100% oxygen into a face mask, the patient is not getting 100% because the patient breathes in, then breathes out into the mask, and then rebreathes the carbon dioxide.

The interesting thing about the nose is that you flush the nasal cavity, which is itself a remarkable reservoir. The patient pulls down this high FiO_2 , actually higher than through the face mask, and then the patient blows out the CO_2 . You then have primed the chamber for the next round of high FiO_2 , out with CO_2 , so at high flow, a nasal cannula provides a higher amount of inspired oxygen than by face mask.

Dr. Glatter: What about nitrogen? That is certainly a component of the gases. What are the mechanics, and how is the nitrogen flushed out?

Dr. Levitan: Historically, preoxygenation required that we ventilate out all the room air, which is 21% oxygen, and then we denitrogenate the lungs. To get the highest FiO_2 into the hypopharynx, you want to insufflate oxygen through the nose.

Now, as we breathe in and out, if we get a high enough FiO_2 , eventually with each breath, we kick out more and more nitrogen. So over 4 minutes, if you can preoxygenate someone with a 100% non-rebreather and you have enough flow, you get rid of all the nitrogen -- and basically, your end-inspiration oxygen has been maximized, so that you no longer have any nitrogen to get out.

The whole theory of preoxygenation was that after enough time, you get all the nitrogen out. But the problem in the emergency department is that often we do not have the time, and when we are intubating, the patients desaturate because we take off the oxygen.

I believe the rebreathing of CO_2 is part of the real problem with face-mask oxygenation.

Dr. Glatter: What is the term "NO DESAT," and how is this relevant to the practicing emergency physician?

Dr. Levitan: This is game-changing for me. My whole experience of emergency airway management had been to push drugs, and then you come to this moment where basically it is all on you. The patient stops breathing, and invariably -- for the first 25 years of my career -- pulse oximetry would start going down, and you had a certain amount of time to get a tube in or all of a sudden the pulse oximetry starts falling. This is a very familiar nurse expression, "Doctor, the pulse ox is falling," but your heart is going fast, you are getting a little bit of sweat, and you know you have to get the tube in. Then, if you did not get it in, you would start bagging.

I found out just how good the nose is for oxygenation accidentally. For some patients undergoing elective anesthesia, the nasal cannula was being left on during induction, and they were using low-flow oxygen; it would buy a few seconds, 30 seconds, 60 seconds, 90 seconds more of safe apnea. I thought to myself, that is pretty interesting. Maybe I should try this in the emergency department (ED).

So I tried it and I thought, why not just turn it up, because I really want to get this oxygen in there? So I started cranking up the oxygen to about 15 L.

The first patient I tried it on was incredible. This patient had a pulse oximetry of 70%, and non-rebreather brought it to 73%. The man was taking 4 breaths/min, his alcohol level was 600 mg/dL, and he was nonresponsive. Fifteen liters of oxygen was not washing him out.

I put the nasal cannula on with the non-rebreather -- 15 liters of oxygen through the nose, 15 liters through the mouth -- and suddenly, the pulse ox is 90% and rising. We tried to rapid-sequence intubate (RSI) him and I left the nasal cannula on, and for the first time in my career, the nurse says to me, "Rich, the pulse ox is going up." I am sitting there playing with a video laryngoscope to try to get the tube in, and for the first time ever the nurse says, "Rich, the pulse ox, it's going up. It's 94%. No, it's 96%, it's 98%." I am thinking, well, this is interesting. Instead of the patient dying and me being all nervous, I can slow down and put the tube in.

Nasal oxygen during efforts securing a tube -- NO DESAT -- is an acronym I came up with. I was sitting in my hot tub wondering how I could come up with a sticky idea to get people to use the nasal cannula.

What has happened has been remarkable. All over the world, people in the blogosphere and the podcasting world have found out that this is worth doing. They started selling it to people, and now I meet people from all over the world who say, "Oh yeah, I intubate with a nasal cannula."

Dr. Glatter: Are there any specific kinds of patients for whom this is more ideal?

Dr. Levitan: Anyone who shows up with severe hypoxemia. I had a career in academic emergency medicine, but now I work primarily in rural New England, and most often, there is 1 doc and 1 nurse.

A patient arrived in the ED last week with a pulse ox of 60%. Emergency medicine techs had been trying to oxygenate him with a non-rebreather. Pulse ox is in the 60s. They try bagging him. It is not going well. He is fighting. I put on a high-flow nasal cannula, and the combination of adding that to the bag valve mask with positive end-expiratory pressure (PEEP) in this really sick person brought his pulse ox up into the high 90s -- so when we got to managing his airway, he was not dying as I was trying to put in a tube.

I have seen the same result in patients with severe heart failure. I run a nasal cannula with a non-rebreather, and the pulse ox levels climb very quickly. For severely hypoxemic folks, those with air hunger -- particularly these people with morbid obesity, and short safe apnea times -- the nasal cannula is really critical.

Dr. Glatter: How about pediatric patients; can we transition to children?

Dr. Levitan: I do not see a lot of kids, but I have had a few. I had an obese 6-year-old with status epilepticus; again, the pulse ox never went below 100%, and we could intubate him slowly.

I know of physicians in this country and abroad who are now considering this to be standard practice, so that infants with pyloric stenosis who are at high risk for regurgitation if you overbag them -- these babies are now being induced with a nasal cannula.

In New Zealand, Paul Baker, an anesthetist who is an airway guru in that corner of the world, uses it on all his pediatric patients, and he says his whole career has changed. In his career practice, it used to be a given that every infant would desaturate, and now he says he does not see it.

Dr. Glatter: That is wonderful. Do you see the non-rebreathing mask as being irrelevant at this point?

Dr. Levitan: Let's be clear. The anesthesiologists using face-mask systems with CO₂ absorption can get much higher FiO₂ levels than we can with a non-rebreather. However, I do believe the future of airway management is nasal oxygenation and ventilation, and that the only thing we are going to put in the mouth is the tracheal tube and that we should not ventilate and oxygenate through the mouth.

I believe we will be seeing specially designed, small nasal oxygenation systems. We do have high-flow nasal cannula and I think we are going to see more and more of those. Unlike what I am using, which are standard nasal cannula, these are warm, humidified, relatively expensive systems. If you want to put a patient in the critical care unit and avoid intubation, instead of putting the patient on continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP), you can use these high-flow nasal cannulas. I believe there will be more and more use of that coming down the pike.

Dr. Glatter: Is there a role for nasoendoscopy with your experience? Any role for this you see with your vast teaching?

Dr. Levitan: If you look at what emergency medicine has been good at and what we are not great at, it took us a while, but we embraced wholeheartedly the use of pharmacologic adjuncts and liberal use of muscle relaxants. Anesthesia is coming around to the realization that these are good. They help when you place laryngeal mask airways (LMAs); they help you optimize the conditions.

However, one of the things we have not done well is teaching the anatomy of the airway, and when you look at exactly what ED docs do, I believe many are still intimidated by flexible fiber optics. When you get these cases where basically the airway has to be managed through the nose or through the neck, we are not as comfortable with that as with direct laryngoscopy, and now video laryngoscopy.

Fiber optics is a huge opportunity. Because we do it so rarely, the surgical airway is something that as clinicians, we have to just train and prepare for, because it saves lives. As the ear-nose-throat (ENT) specialists are backing out of this, more ED docs need to develop that fiber-optic and surgical skill.

Dr. Glatter: What kinds of learning opportunities are there for physicians, emergency physicians, to learn nasoendoscopy? How do we embark on this?

Dr. Levitan: This is interesting. I believe that people have a perception that it is a huge hurdle -- that somehow this is not in their skill set. Over the past 2 years, I have probably taught a dozen classes with private groups where I take a whole bunch of scopes, we hook them up to monitors, we put on sheaths, and we scope ourselves and each other. I pioneered and really pushed cadaveric education, and that is unrivaled. I do that monthly in Baltimore.

Dr. Glatter: Okay.

Dr. Levitan: I am also starting workshops on nasoendoscopy and fiber-optics advanced airways/surgical airways. I am starting in May and June in Yellowstone, and then in the fall in New York, and I have invited a whole bunch of airway nuts to help play.

Dr. Glatter: I appreciate your time. It is quite amazing that the technology is advancing, and this could be a significant change in practice. Thank you again for joining us.

Dr. Levitan: Thank you, Rob, for having me. I appreciate it.

Dr. Glatter: And thanks for joining us at AAEM.

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