Tampa Bay EMS Journal

Volume 1, Number 4
April - June, 1988

PROTOCOL ROUNDTABLE

Airway Control and Ventilation

The following article contains an edited transcript taken from the Protocol Roundtable Symposium sponsored by the Acute Care Foundation in Tampa, Florida on March 2, 1988.

The Protocol Roundtable is a session in which paramedics, physicians, nurses and other acute care clinicians review a specific emergency disorder. This entails discussion of the pathophysiology, clinical recognition, therapeutic objectives, review of current EMS agency protocols, and a computerized literature search. The session culminates in a "roundtable" group discussion to develop a model protocol.

Securing an airway and providing ventilation are among the most basic tasks in emergency medicine, and among the most important. The session began to consider airway access and ventilation as separate protocols, but the structure appeared to be more appropriate as a single integrated sequence.

A lecture on the clinical anatomy and physiology of ventilation was delivered by Michael Gunderson, REMT-P and appears elsewhere in this issue. Michael Brown, REMT-P, from the Hillsborough County, Florida EMS system, delivered a presentation on airway access. Brian Cobb, MD provided a lecture on mechanical ventilation, also appearing in this issue. After discussion of the airway and ventilation literature search, also in this issue, the model protocol development effort was moderated by Mr. Gunderson.

Protocol Structure

Mr. Gunderson: *(Michael R. Gunderson, REMT-P, Palm Harbor Fire Department / Pinellas County EMS; Tampa, FL; - Moderator)* We will list out what our therapeutic objectives are in getting the airway open, and then we'll try to choose which specific therapies we might want to use to meet those therapeutic objectives. We, of course, want to have a patent airway. And perhaps that might be the limit of our therapeutic objectives. What we might want to do is consider a spontaneously breathing patient, an apneic patient, and patients with or without cervical spine injuries. Dr. Nelson?

Dr. Nelson: *(Joe A. Nelson, DO, Emergency Department, Carrollwood Community Hospital; Tampa, FL)* I would like to break this into something a little bit more detailed, and that is, a fast patent airway versus something that takes a little longer. My idea is a recommendation for stepwise airway management beginning with something you can do immediately that's a sure thing -something as simple as putting in an oral airway. Then use some sort of a mask device until the patient can be further managed or until inserting something that's a little more secure and safe.

Mr. Gunderson: Instead of discussing this as separate airway access and ventilation protocols, perhaps we should consider this in terms of an airway support and ventilation protocol - one single protocol in which this sequence of events could take place for the spontaneously breathing patient as well as the apneic patient. Anybody have any feelings on that? For example, Dr. Geeslin, in your system, do you have a specific protocol for airway access separate from ventilation, or is it blended together?

Dr. Geeslin: *(John L. Geeslin, MD, Medical Director, Lake County EMS; Eustis, FL)* We're more like Dr. Nelson states in that you try to go stepwise from what you do immediately or initially to what you do later on to secure your airway.

Mr. Gunderson: Any other feelings on this? Do we have a consensus about blending together the airway access as well as the ventilation protocols? Do you think it would be appropriate for us to consider as a separate sequence the spontaneously breathing as opposed to the apneic and/or arrested patient? Gene?

Mr. Scarberry: *(Eugene Scarberry, Respironics Corp.; Monroeville, PA)* That's just simply shades of the same patient. What breaks apart easily is the C-spine injury potential patient and the non-C-spine. If you take both of those and follow a path of C-spine injury: spontaneously breathing, troubled breathing, apneic, non-C-spine injury patient, — you may find some deviations as you break down the decision tree.

Dr. Cobb: I think the presence or absence of spontaneous ventilation is important, though, because it may influence your choice of techniques. For instance, nasal technique is probably going to be your first choice of intubation routes for the patient who is spontaneously breathing. For the apneic patient, you're going to go with an oral intubation. So I think that there would be some differences there that may be important.

Mr. Brown: *(Michael Brown, REMT-P, Hillsborough County EMS; Tampa, FL)* It would seem that our starting point in the therapeutic objectives is to differentiate the trauma from the non-trauma patient as the first therapeutic objective when considering airway management or airway assistance. As Gene said, it neatly divides into the trauma and the non-trauma patient, and then you follow a decision tree from that point.

Mr. Gunderson: That seems reasonable to me using the "trauma"/"non-trauma," and the "spontaneously breathing" versus the "apneic" patient. I'm just trying to limit the number of permutations we can have.

Mr. Brown: The decision tree should start from those two points (trauma / non-trauma), then immediately go to "spontaneously breathing with adequate respirations" or "inadequate respirations and/or apnea." In which case, you would choose between simple supplemental oxygen and then the need to assist ventilations. Those are identical for the trauma and non-trauma patient. In terms of specifying a protocol, simply identify the trauma versus the non-trauma patient. For the trauma patient, we would also have to include immediate manual management of the cervical spine.

Dr. Nelson: For purposes of time constraints, I would suggest that we just put the patients with adequate ventilation that need supplemental oxygen off to the side. I don't think we should consider those here. I think we should just consider those patients that we know are going to need some sort of an artificial airway management such as endotracheal intubation.

Mr. Gunderson: And they could simply withhold the ventilatory component if they have an adequate spontaneous tidal volume.

Dr. Geeslin: What you might do in your first step, is evaluation of their airway - That's number one. Then, you break that down to two trees. The first one is going to be "adequate" or "near-adequate needing supplemental oxygen." We can kind of not watch that one for a minute. Then we can go to "inadequate," which would be either "severely compromised" or "apneic." Then break that down into "trauma" and "non-trauma."

Mr. Brown: The reason for inserting the differentiation between "trauma" and "non-trauma" early on is the basic airway maneuvers need to be accompanied by manual cervical management. This is the way that it's included in all the trauma life support curricula.

(See Figure 1 for the decision tree structure)

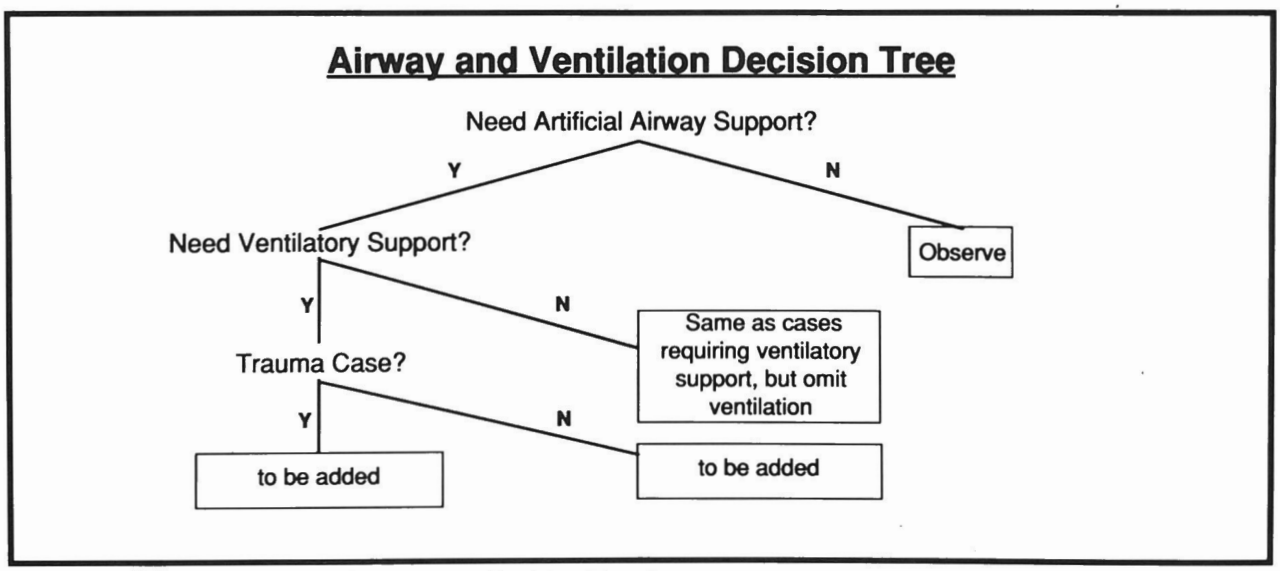

Figure 1 - Airway and Ventilation Protocol Decision Tree Structure

Airway Candidates

Mr. Gunderson: Determining whether or not the patient needs an airway, that's fairly clear cut. Maybe it isn't. Which patients should receive an artificial airway? Brian?

Dr. Cobb: First of all, any patient who is manifesting evidence of airway obstruction as indicated by stridor, by the presence of secretions in the oral cavity, by impaired level of consciousness, or in patients that are not able to defend his or her own airway.

Mr. Brown: For a patient requiring supported airway patentcy, the patient needing to be guarded against secretions or vomitus, and the patient requiring ventilations. Those seem to be three clear ones.

Mr. Gunderson: The obstruction would be all of the secretions and whatnot. The reduced level of consciousness being those people who are not able to protect their airway. That seems to be workable for which candidates need the airway. Is everybody comfortable with that?

Mr. Brown: The third one that needs to be put on there is the patient requiring ventilation - That's the obvious one.

Dr. Cobb: There's a third category of apnea or hypoventilation.

Mr. Gunderson: This is where we had some controversy earlier this afternoon - deciding which patient is adequate and which patient is

inadequate in terms of their spontaneous respiratory effort. Obviously the patient who is apneic will clearly be in this inadequate category, but how can we discriminate between the patient who needs and doesn't need ventilatory assistance by artificial means? Gene?

Mr. Scarberry: Would not the circumstances in which you find the patient suggest a need? - such as he's been burned, has been in an automobile accident, or received trauma to specific parts of his anatomy to where you would want to guard or where your suspicion level is higher, where you would then say for an insurance policy, I'm going to proceed to do something as opposed to just simply asking what are the clinical symptoms? The same set of symptoms on two different patients may produce two different modes of procedure.

(See Figure 2 for factors to consider in determining need for airway intervention)

Selection of Cases Needing Ventilatory Assistance

Mr. Brown: Something that is a little more difficult as far.as decision-making is the alert patient who has an.adequate tidal volume but who requires ventilatory. assistance. And I'm speaking specifically of, for instance, a congestive heart failure patient that needs to have his respiratory work eliminated and simply needs that ventilatory assistance or they will rapidly progress from congestive failure to cardiac arrest.

Mr. Shepler: *(Patrick Shepler, REMT-P, Clearwater Fire Department / Pinellas County EMS; Clearwater, FL)* What are some of the parameters that would determine who requires assisted ventilation? Restate the question.

Mr. Gunderson: What we're concerned about is differentiating which leg of this decision tree we want to go down. Are they adequately ventilated and they simply are going to need an airway, or are they going to need an airway plus ventilatory assistance? All of the patients are going to need an airway. Which patients are we going to need to supplement ventilation in?

Mr. Shepler: I think the initial criteria should be rate of respirations. We could come up with some type of term as far as the rate.

Mr. Gunderson: That's something solid. We can deal with that. Anybody have a number? Should we deal with a number, or should we look in terms of minute volume? We can't measure alveolar minute volume because we don't know what their dead space is.

Mr. Shepler: Part and parcel with the rate is going to also be the chest wall expansion. If there are intercostal and subclavicular retractions, if the patient is retracting versus breathing normally, if they have symmetrical respirations.

Mr. Gunderson: Let's pull back from this. Dr. Geeslin, you have a patient who is breathing spontaneously but not real well. What things would you look at to decide whether or not you need to provide supplemental ventilation? - Clinical signs, things that would be available to your paramedics in the field?

Dr. Geeslin: Well, first of all you have to diagnose or define "real well." This is a real problem because we're dealing with paramedics in the field. And as we discussed earlier today, we have very little that we can actually quantitate for specific parameters. I think you mentioned their respiratory rate, skin color, whether or not they're cyanotic, whether or not they're using the accessory chest muscles. These are certainly all indications of how well that patient ventilates. Also you have to consider their level of consciousness - are they restless? Are they sedated from it? You have got to take everything together. That's a real problem when we're dealing with the brand new paramedic out in the field. This is his first run as a paramedic, and he comes on an elderly lady with status asthmaticus. Well, is it cardiac asthma, or is it because she went out with goldenrod? That's where we have the problem. I see a lot of difficulties in making out a set protocol that says, "In this case you do this, and in this case you do that" because it's gray. It's not black and white.

Mr. Gunderson: Maybe we just have to accept that fact. Simply delineate some of the clinical signs and circumstances under which it would seem that ventilation may be inadequate. Simply list those and chalk it up to clinical judgement.

Dr. Geeslin: I think you have to make a protocol for your brand new or weakest paramedic. You don't make it for the hot-dog person who has ten years of experience, who's worked in emergency rooms, who's been out in the ambulances, and who has done teaching. He's going to be as good as we are - maybe better. You have to make it for your weakest man, something as objective as we can.

Mr. Gunderson: This brings up an issue we brought up at the last protocol meeting - At which level the model protocol should be directed? Should we go for this least common denominator factor, which would be the brand new paramedic who doesn't have a lot of clinical experience to base his clinical judgments on? Should we go for a median? Should we shoot for an optimal from which we would simply allow the medical directors for the different agencies to make their own assessment as to how much of the model protocol they may be ready for at whatever point in time? Consider the wide disparity in experience levels between agencies, busy systems versus slow systems, systems with very intensive continuing education and medical control as opposed to those with less intensive training and continuing education. What we're trying to do, and I appreciate your concern, is to aim for an optimal protocol, taking a near optimal set of circumstances given the constraints of the field. From that point, the agency and you as a medical director for your agency, can see which components from the model protocol you feel comfortable with. It might even be a goal to which you would try to gear your continuing education and medical control to capacitate. Mike?

Mr. Brown: With the optimal protocols stated, it can be up to the medical director to draw a line through that protocol and say, "Beyond this point, mandatory physician contact is required." The only unfortunate circumstance here is that airway is usually a high priority, and in the manpower poor environment that we encounter prehospital, it can be very difficult to continue to

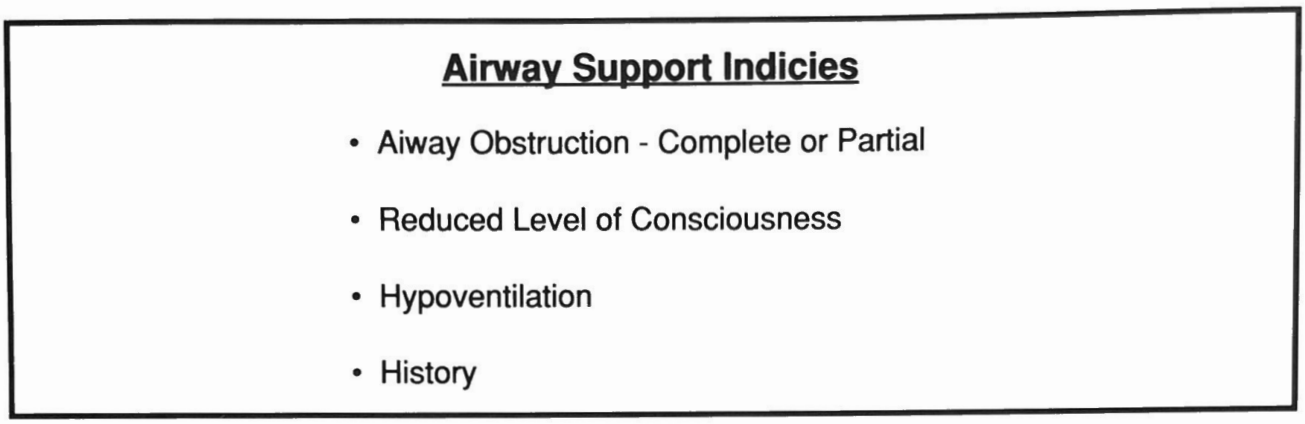

Figure 2 - Factors To Consider in Evealuating Need For Airway Support

maintain the patient at a certain state and communicate not only adequately but coherently with a physician in order to get those orders at that time. So we do have to limit here, and I certainly appreciate that, but once again the optimal protocol can be stated beyond which physician contact can be mandated.

Dr. Nelson: I think we need to first of all lay aside the discussion we had earlier today - I don't think that spirometry and oximetry and these things at this time are of sufficient value to make a distinction in whether or not we should intubate someone.

Mr. Gunderson: Good research topics, but not ready for widespread application?

Dr. Nelson: I think they may be very valuable in the future, but at this time I don't think we're far enough along on the research to be able to put that as a definite parameter. So what are we left with? We're left with physical evaluation and clinical judgment. And I think the simplest way to do that is much as we did the last Protocol Roundtable discussion. That is put some parameters, physical exam parameters, in our criteria such as respiration rate. Just throw that out to start with. What are some minimum respiratory rates below which you would like to see intubation or some sort of aggressive airway management to take place?

Dr. Cobb: That's age dependent. If we're talking about adults, I would say a respiratory rate of less than eight to ten would be a range where I would start to feel uncomfortable and consider instituting mechanical ventilation. Obviously in a neonate, we could say less than 24. It's going to be somewhat age dependent.

Mr. Gunderson: Let's restrict it to adults. Pediatrics bring in a whole new set of constraints. So which number?

Dr. Cobb: I would say less than eight to ten respirations per minute is the range at which the presence of cyanosis certainly appears.

Mr. Gunderson: Let's stop at the respiratory rate. Anybody have any disagreement or comment on eight to ten? Now, cyanosis —

Mr. Brown: Before we get to cyanosis, let's go to the top end of respirations. Usually that's coupled with another clinical observation, and that is heart rate. Heart rates in excess of a certain amount coupled with — or below a certain amount coupled with tachypnea should also be an indication that this patient should be evaluated for intensive airway management.

Mr. Gunderson: Dr. Geeslin, does that sound reasonable?

Dr. Geeslin: I agree.

Mr. Gunderson: What number heart rate would set off a red flag with you in the context of a patient who may be inadequately ventilated?

Dr. Geeslin: It depends on the age of the patient. I think anything over a hundred you're really going to have to look at.

Dr. Cobb: Less than 60 or greater than a hundred —

Mr. Brown: Coupled with tachypnea over —

Dr. Cobb: Well, we can come up with a number of parameters for respiratory rate —

Mr. Gunderson: Exactly.

Mr. Brown: Any patient with a heart rate greater than 120 with respiratory rate over 30 - I consider that person should be evaluated for intubation regardless of their state of alertness, which is why I think that the heart rate should be coupled specifically in this instance with a respiratory rate as a clinical deciding factor; certainly the lower end of the respiratory rate is an indication. Tachypnea coupled with the other evidences of elevation of sympathetic tone is another indication.

Mr. Gunderson: So we're looking at the respiratory rates below 8, greater than 30, heart rates lower than 60, greater than 100. Does everybody feel comfortable with that?

Mr. Shepler: I don't feel particularly comfortable with saying that as a carte blanche.

Mr. Gunderson: They are not. These are not definite. These are clinical guidelines that are put together with the cyanosis, mechanism of injuries, and other circumstances. These are simply factors that we're going to ask the clinician to consider in deciding which leg of the decision tree he's going to follow - if the patient is adequate or inadequate in ventilation. These are the parameters he should look at, but it will not be an absolute because I think we've already come to a conclusion that absolutes are darn hard to come up with. We could go with apnea, but everything else seems to be gray.

Mr. Brown: Pallor, diaphoresis, or cyanosis.

Mr. Gunderson: Abnormal skin color.

Dr. Cobb: Presence of intercostal or supraclavicular retractions, accessory muscle usage, decreased level of consciousness, certainly, or profound agitation. Arrhythmias on EKG monitoring - ventricular arrhythmias especially.

Mr. Gunderson: Anything else figure into this equation?

Mr. Brown: Gastric contents in the oral cavity.

Dr. Cobb: We're back to our obstruction criteria there.

Mr. Gunderson: Realizing the limitations of this decision, in looking at the overall patient, does everybody seem to feel we've tagged the appropriate bases in deciding which leg of the decision tree we're going to go with? Adequate or inadequate ventilation? We simply have to consider these factors in making the decision and rely on clinical judgment. Any more detail you can see in this, Dr. Geeslin?

Dr. Geeslin: Do you want to put something in there about auscultation? If you feel that they've got a significant decrease in breath sounds, if they've got a lot of rales or rhonchi, a lot of bronchospasm or wheezing.

Mr. Kinsey: *(Dave Kinsey, REMT-P, Clearwater Fire Department / Pinellas County EMS; Clearwater, FL)* Don't forget stridor.

Mr. Brown: Fulminant pulmonary edema.

Dr. Cobb: Which would be diagnosed, as he said, if the rales are present. Then that's going to fall under the abnormal breath sounds.

Mr. Gunderson: Frothy sputum.

Mr. Brown: Well, certainly someone who actually has pulmonary edema visible as an expectorant.

Dr. Cobb: Frothy sputum.

Dr. Geeslin: Now we're back to obstruction again.

Mr. Gunderson: Yes, we are. We can probably just leave that out, then. Okay. Taking the listing here on the table into consideration, are we ready now to move further down the tree to the traumatized versus the non-traumatized patient?

Mr. Shepler: We can add one more thing, Mic, - capillary refill. Do you think it's covered?

Dr. Cobb: I think that's more an indication of cardiac output, a volume status than respiratory status per se.

Mr. Gunderson: That's a perfusion indicator that may not be specific enough to ventilatory function. The color, yes. We've got the skin color and the skin moisture, but the capillary refill itself I don't think is specific.

Dr. Geeslin: Do you think it's reasonable to put anything to do with the history, what the patient tells you? Because you can have a lot of those be normal and the patient says "I'm suffering" or "I'm smothering to death." And I don't know, a lot of that is subjective, and we should include that in there. I would like to hear someone else's opinion on that.

Mr. Brown: For instance, the patient on beta blockers who is in congestive heart failure is going to mask many of the things such as pallor, tachycardia, and diaphoresis.

Mr. Gunderson: Gene, you mentioned something I remember earlier in the discussion about history or circumstance?

Mr. Scarberry: I was more referring to the location in which you find the patient in view of the trauma discussions. The patient's history and the patient's verbal account is an excellent way.

Dr. Geeslin: You can have a patient who says they are significantly short of breath and really that's not their problem. But I just was wondering if we should consider it or not?

Dr. Cobb: I think that's an important point. More often than not in my experience, when patients tell you, "I'm going to die," they're right.

Dr. Geeslin: They do.

Dr. Cobb: So I think that's something that you have to consider.

Mr. Gunderson: How could we phrase that eloquently? Just "symptoms"?

Dr. Nelson: History - history of the chief complaint.

Mr. Brown: Subjective findings?

Mr. Gunderson: That would be symptoms. History and symptoms?

Dr. Nelson: A specific case that comes to mind is one that someone mentioned earlier. That is the case of a burn injury involving the airway. It may not be an immediately apparent problem.

Mr. Gunderson: But it's a very high potential for obstruction.

Dr. Nelson: High potential for obstruction even though there may not at that time be an actual obstruction, so we want to be able to include that under history and symptoms.

Mr. Gunderson: Ron, what do you think of all this? Is this making sense? Are we on the right track?

Mr. Johnson: *(Ron Johnson, REMT-P, Brevard County EMS; Cocoa, FL)* I believe so, yes.

(See Figure 3 for factors to consider in determining need for ventilatory assistance)

Airway Support of Trauma Cases

Mr. Gunderson: Now, let's take the harder one first. Let's take the traumatized patient, who we've decided by whatever mechanism is going to need an airway, and he's going to need ventilatory assistance, using these criteria. How should we go about securing their airway? We have a trauma victim. He's in whatever position, in the car or out of the car, and we need to make our first initial step on his airway? Dr. Nelson?

Dr. Nelson: Before we start anything further, we need to include C-spine control. Now, we don't have to delineate that for the purpose

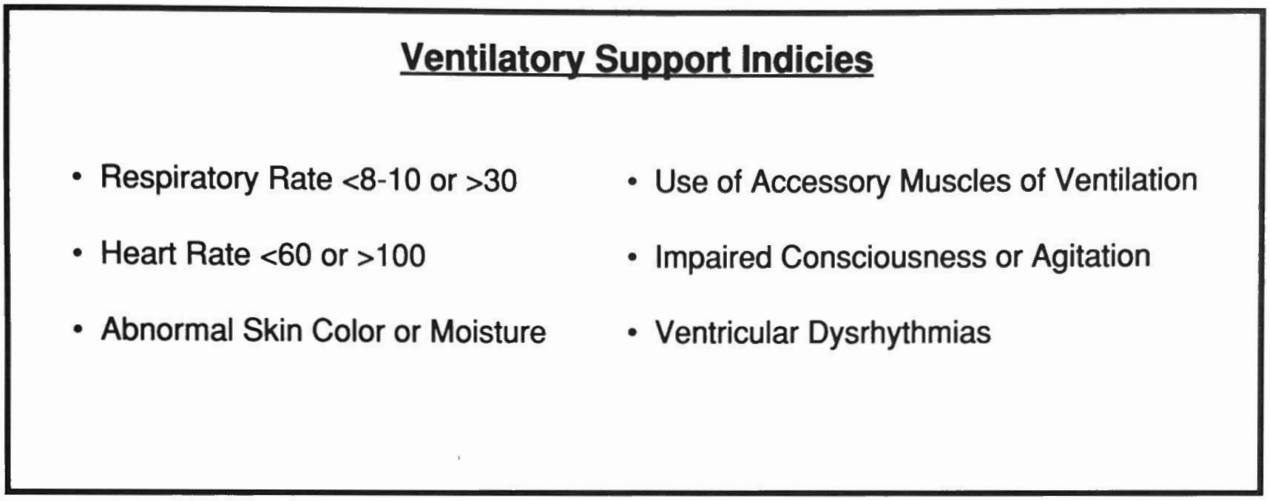

Figure 3 - Factors To Consider in Evaluating Need For Ventilatory Support

of this discussion, but we must include airway with C-spine control. And that should pervade throughout the trauma part of this algorithm.

Mr. Gunderson: Right. Let me digress just a moment conceptually in use of the protocol. Any given patient may require more than one protocol. We may have a patient who has respiratory embarrassment who is going to need an airway secured. He will need ventilatory assistance. He may also have a dysrhythmia in which case he might be falling into a ventricular ectopy protocol. He may also have some other injury following a different protocol. In this protocol, we want to concentrate on the respiratory components of the patient's problems, keeping in mind that we may need to also use a multi-system trauma protocol to include cervical spine protection.

Mr. Brown: It's generally not difficult to determine who is going to fall into the category of "trauma" versus "non-trauma." If they're a trauma patient, include cervical spine management with all that it implies. When we're selecting methods of placement of specific airways, then you have to re-include that in your decision tree.

Dr. Cobb: I think at this point in the decision tree we need to address whether the patient is spontaneously breathing or not. That's going to affect the method that we use to secure the airway.

Mr. Gunderson: If there is any ventilation at all in this stage of the decision tree, it is inadequate and it's going to require supplemental breathing.

Dr. Cobb: But it's still going to be different at this point. I would say that the patient who say is having respiratory embarrassment but still has spontaneous respirations would be a candidate for nasal intubation whereas the patient who is apneic now is not a candidate for nasal intubation, and our airway technique of choice is going to change in that patient. And we can get into that discussion in a minute, but I think that whether the trauma patient is spontaneously breathing or not is an important discrimination point.

Dr. Geeslin: Are they structurally intact? Do you have all your avenues available to you, or are you limited because of either copious amounts of blood or damaged facial structures where you really couldn't pass either an NT or an oral tube? In that case, you have only one choice.

Mr. Gunderson: So the first thing we're going to have to decide is whether or not we're going to need to go to cricothyroid or if we can come in from the top.

Dr. Cobb: We could actually branch the decision tree. One thing is going to be either apneic or severe mid-face injuries because those are going to have the same management, essentially.

Mr. Gunderson: They might not have the same route of access, though. All apneic patients won't necessarily require a cricothyroid airway whereas the mid-face injuries —

Dr. Cobb: Well, in view of the recent data I would wonder about that.

Dr. Nelson: You are saying that any patient that has sustained trauma and is apneic requires cricothyroid puncture?

Dr. Cobb: At this point the other methods are not clear. Orally intubating these patients, at least as traditionally taught using axial cervical traction, has now been demonstrated to be unsafe and, therefore, that method is out. Nasotracheal intubation, at least in most of the literature, is considered to be contraindicated in a patient who is not spontaneously breathing. Presumably, you could try retrograde intubation as opposed to cricothyrotomy, but as was pointed out earlier, that still involves a cricothyroid membrane puncture.

Mr. Gunderson: Well, let me ask you this, Dr. Cobb. When you have a patient today who is apneic and has sustained trauma, do all of them get a surgical airway in your hands?

Dr. Cobb: I would do that, yes.

Mr. Gunderson: Okay. Dr. Nelson, how would you handle this patient? He's apneic and has sustained trauma. He's in bad shape.

Dr. Nelson: I don't do surgical airways on every patient that is apneic and has sustained trauma. I know some centers recommend that, but I would like to see some sort of oral or nasal route of endotracheal intubation prior to attempting a surgical airway. I think that the retrograde intubation using a cricothyroid puncture with a guide wire is still an acceptable and a good method of accomplishing this intubation without compromising a cervical spine injury.

Mr. Gunderson: Initially what should they do? We still haven't even put in an oral pharyngeal airway. We still haven't put in a nasopharyngeal airway. What would be our first intervention?

Dr. Nelson: Oral or nasal pharyngeal airway with a modified jaw thrust.

Dr. Geeslin: And suction if indicated.

Dr. Cobb: As a first measure, yes.

Dr. Nelson: Does anybody disagree with me on that? Does anybody say we should go directly to intubation?

Mr. Gunderson: All right. So we have a pharyngeal airway in place now. We have the patient suctioned, if needed. We're going to need to ventilate them because we've decided that it's inadequate. How can we supplement their ventilation at this point? Should we use the bag? Should we use the demand valve? Should we use an automatic ventilator? We're in the mud and the blood and the beer right now.

Dr. Cobb: At this point I think I would go with a bag mask device with 100% oxygen.

Mr. Gunderson: Any discussion on that point? Okay. We have a pharyngeal airway. We have the patient suctioned, and he's now being ventilated with a BVM with supplemental oxygen. Obviously we want to get a more secure airway because secretions can still come in. We can develop edema, et cetera. We need a more definitive airway. Again, we realize the patient has the potential for cervical trauma, and we need to be cognizant of that. Mike, you gave the lecture on airway control. In your opinion, what at this point is the airway device and approach of choice? This is a trauma patient.

Mr. Brown: It depends on their state of consciousness. As I said before, certain quiescent patients can become very combative once you start stimulating their airway. At this point I would choose for the apneic patient an airway other than an endotracheal tube because we have to do cervical management. We can't be certain about the placement of an endotracheal tube if we introduce it nasally in this apneic patient. The literature indicates that we should go directly to cricothyroid puncture at this point. We do have other airway devices, for instance, the pharyngeo-tracheal lumen airway. That is one alternative. If you have a patient who does have spontaneous ventilations, as long as they don't have massive maxillofacial injuries, then blind nasal intubation is indicated. If they have no maxillofacial injuries, then we would have to proceed with an oral intubation. It occurs to me I didn't talk about the digital intubation nor did I talk about transillumination. If you have the apneic patient you can always choose one of those two methods - transillumination or digital intubation.

Mr. Gunderson: Let's consider the apneic patient here. We have a traumatized patient. We've decided that they need an airway, and we've decided that they need ventilatory assistance because they are apneic. Okay. We've narrowed it down a little bit. I hear concerns about whether or not they have maxillofacial injuries or not, and their approaches seem to be very different. I don't want to get it again real complicated, but if we have maxillofacial injuries, which one would we then want to go with?

Dr. Geeslin: You may want to bypass all of your first three or four steps up there. If they've got significant facial injuries, to be sticking in a pharyngeal airway, again with a jaw thrust, and putting a bag valve mask over them probably is not going to do any good, wastes a lot of time, and may cause further injury. So if you've got a massive facial injury, particularly with significant bleeding into the oral cavity, go straight to your cricothyroid.

Dr. Cobb: I agree completely.

Mr. Scarberry: I sat in on an airway lecture four days ago in Las Vegas, and they showed exactly the patient you just described. They passed two nasal airways into what was a horrendously destroyed face, opened the airway, used those two devices, and ventilated the patient properly, and that's all they had to do. They brought them in alive.

Dr. Cobb: They were lucky they didn't pass them into the frontal lobe or somewhere else.

Mr. Scarberry: No, I did not say nasotracheal tubes. I said just simple nasal airways.

Dr. Cobb: Still, you can't be assured of the direction they'll take. And there are devices that are blindly placed and somewhat rigid. And I just think in a patient who has a potential for a cribiform plate fracture or open sinus fractures and so on, the potential of false passage is just too high to recommend blindly passing any sort of tube through the nose.

Mr. Gunderson: Were they able to keep the lungs clear of blood in that case, Gene? They survived, but —

Mr. Scarberry: All I heard was the presentation, and he simply showed an example of one patient. When they passed this first tube in, the patient started breathing on his own and that's all they did. He stayed breathing on his own while they transported him to the hospital.

Mr. Shepler: I would like to make a suggestion. I agree with Dr. Cobb that the literature has stated that with the possibility of cribiform plate fracture, nasal intubation is contraindicated, though more studies do need to be done in facial fractures including mandibular fractures. Access of the trachea is possible with blind endotracheal intubation and also with use of the transillumination method, either using digital method with transillumination or what was described and not mentioned in the airway lecture is a hooked method described by Stewart and Paris. One thing in the real world is that these patients will often be very hypoxic because of long periods of airway compromise, and so rapid airway access is important. They have found that they were typically able to achieve airway access by the hooked stylet method within approximately 20 seconds.

Mr. Gunderson: So how about if we made a statement saying if they have maxillofacial injuries, consider the following airway interventions: Consider cricothyroid, consider lighted-tip stylet, consider —

Dr. Nelson: Retrograde.

Mr. Gunderson: — retrograde — well, we're still at square one. At that early point, would we want to include retrograde? They're getting no ventilation at all right now.

Dr. Nelson: Sure.

Dr. Cobb: I think retrograde is questionable in the patient who is not breathing spontaneously.

Dr. Nelson: Not at all. I've been involved in it being done at Tampa General at least twice. and it's worked well both times - both patients were non-breathing or barely breathing.

Dr. Cobb: I still think you can probably establish an airway faster just with cricothyrotomy. And again, you don't have as much potential for false passage as you do passing the guide wire. But that's a matter of individual preference. I think the clinician's skill and experience has to be weighed in there. I think that either method would be appropriate. This is my preference, but, you know, Dr. Nelson feels comfortable with the retrograde, and I'm sure in his hands it's a good technique.

Dr. Geeslin: Remember, we're talking about paramedics out in the field even though we may be talking about protocol, it's not in the emergency room at all.

Mr. Shepler: Dr. Cobb, have you had any experience with trans-tracheal jet insufflation? And what about that as a temporary maneuver?

Dr. Cobb: I have not had any personal experience with it. I will say that I do have reservations about the technique for a couple of reasons. One is there have been many reports of hypercapnia developing in patients ventilated that way. Oxygenation doesn't seem to be as much of a problem, but hypercapnia can develop. The other is that I think your airway is still unprotected from secretions. Some people claim that at least on theoretic grounds that the rapid insufflation will displace the secretions into the oropharynx, but I think that is not proven. We still have to consider that as an unprotected airway where there's a great potential for aspiration. I think it can be a useful temporizing measure, but I do have some questions about it.

Dr. Nelson: Two points. When was the last time that you assembled and carried the equipment required for trans-tracheal jet insufflation? It's very hard to find, and it is difficult to carry. And you have to assemble it. It's a technically difficult thing to do. The second point I would like to make about trans-tracheal jet insufflation is take a 14-gauge or even a 12-gauge catheter and attempt to breathe out through it. The problem of hypercapnia is a significant problem with trans-tracheal jet insufflation. And I'm not sure you won't build up severe airway pressures by trying to jet oxygen through that small catheter without allowing any way for it to escape. That's been my experience with jet insufflation.

Mr. Gunderson: We've got the cricothyroid access. We're considering using the blind-lighted stylet intubation with the hook technique described by Stewart, et al., and we have retrograde intubation. These are just airways to have in your back pocket, so to speak, to call upon if the circumstances indicate. Are there any other airways with this massive maxillofacial injury that would be appropriate?

Mr. Scarberry: PTL (pharyngeo-tracheal lumen airway)

Mr. Brown: Tactile oral.

Dr. Nelson: Mic? I would like to reverse my position on the retrograde intubation. I don't think it's indicated for a patient with maxillofacial injuries. I should not have put that up there because it would be dangerous to pass a guide wire. I think it should come off of there. I think it's useful in other circumstances, but I don't think it's useful in facial injuries.

Mr. Gunderson: We have a number of airways. We do not have the EOA in there. I think that's because it can still allow bleeding to get into the trachea and into the lung.

Mr. Brown: I would like to point out that in the majority of the cases, blood would be coming from one of three sources, from the nasopharynx and the nasal sinus, from the oral cavity, and from the esophagus, in which case any type airway with a palatine balloon and with an esophageal obturator balloon will keep the airway clear from secretions from those sources.

Dr. Cobb: I will have to interject this. Those are good theoretical points, but I would have problems recommending this device in a protocol at this point because I don't think that there's been sufficient research done on that point to justify recommending it. I think that before we recommend something for general use in a protocol, that it should be something that's tried and true and that has some support in empiric experience. And that, again, is my reason for favoring the cricothyrotomy. It's a proven procedure that's been used for many years by a number of clinicians all over the world, and it has a demonstrated record of efficacy and safety. And these other things may be appealing on theoretic grounds and may in fact eventually supplant cricothyrotomy to some extent, but at this point I don't think that it's prudent to recommend things until they have undergone testing in the subgroup of patients for whom we're recommending their use.

Mr. Gunderson: Your apprehension with the PTL is the effects of the palatine balloon on head trauma?

Dr. Cobb: We're blindly passing a device into the oropharyngeal cavity in a patient with facial injuries. The potential for creating false passages and so on is just, in my opinion, too great to recommend that without some studies to demonstrate its safety.

Mr. Scarberry: The studies in terms of the palatine cuff occluding upper airway bleeding are in the Annals of Emergency Medicine. That's already published data using barium as opposed to using blood, but they did a study on cadavers. I thought the Trauma Society had recognized EGTA as a legitimate blind passage device in cases of facial trauma - that was an accepted device.

Dr. Cobb: At least in the current American College of Surgeons' guidelines in the Advanced Trauma Life Support curriculum, cricothyrotomy is still the recommended airway access in these cases. And, again, although there are cadaver studies using

barium, I would not want to be on the witness stand as a defendant in a malpractice trial and have to cite those as my clinical studies to support. I agree that it may well be a good device in this setting, but I think that until someone has done an adequate clinical trial in real trauma patients, that we should confine our recommendation to things that have been proven by experience.

Mr. Brown: A question, then. What current literature is there which documents false passage of any large, blunt object passed orally?

Dr. Cobb: Or that doesn't? I don't know.

Mr. Brown: The majority of the literature that talks about blind false passage refers to percutaneous as well as surgical cricothyroidotomy and most especially the passing of any device through the nose. So I would ask the question when it comes to this device which is to be passed orally, is there any documented incidence of false passage?

Dr. Cobb: Again, I would fall back on the argument that there are no documented series in which the safety has been proven. And although on the theoretical grounds that you're citing, I think it probably is appealing and would merit study, I just don't think that it's wise to include in a protocol something that's really unproven.

Mr. Brown: Then back to the practical aspect. Clinical privileges for cricothyroid puncture, surgical or percutaneous, are generally not within the protocols of many paramedic services. There are some exceptions. Given this other device (PTL) - which is more practical? To upgrade paramedic training to cricothyroidotomy or to give them this other device (PTL) that can be passed orally? We do have a dilemma here either way you look at it.

Mr. Scarberry: Are we really saying we're recommending? Or are we simply saying - here are the things loaded in your own armamentarium. There may be situations where one — any given device is totally not going to work. It may be in the protocol, and it may be the appropriate device. But when you make the final clinical assessment, you go, "No way - I'm going to go to Plan B or Plan C." I think we're simply listing a group of plans, and then it becomes up to the director or whoever to say "That plan is the appropriate one in my system" or "I'm giving you all three options in my system."

Mr. Gunderson: Brian, would you feel comfortable with that, or do you still have quite a bit of reservation about the esophageal devices in trauma patients?

Dr. Cobb: I would at least emphasize that I would strongly consider or recommend the cricothyrotomy and consider these other things as alternatives. I agree that in any given situation one needs to have therapeutic alternatives. And these unproven modalities could be considered as viable alternatives, but I think that, echoing the recommendations of the College of Surgeons, I would still recommend the cricothyrotomy. And as to the issue whether paramedics can do cricothyrotomy or not, that is going to be at the discretion of the medical director of that system knowing full well that any course you choose does have some pitfalls.

Dr. Nelson: I would just agree with Dr. Cobb in that we should recommend cricothyrotomy as the first choice with consideration given to the other indicated means.

Mr. Gunderson: Let's take this as a given, then. If we have the trauma patient we've previously described, he has a severe maxillofacial injury. Our primary airway access method may be cricothyrotomy, but being cognizant that other interventions as shown in our diagram may be appropriate. Now, for the patient who does not have significant maxillofacial trauma, we would then insert the pharyngeal airway with the modified jaw thrust, use suction as appropriate, institute ventilation with a BVM at 100% oxygen. And where do we go from this point? These are all definitive airways. But for the patients that just have the pharyngeal airway, how do we establish a definitive airway for them? Are those the same choices? Are they applicable?

Dr. Cobb: I think it would depend on whether the patient is breathing or not. If the patient is breathing spontaneously and does not have mid-face injuries, I think that the method of choice would be blind nasal intubation or styletted nasal intubation. However, if the patient is apneic, then you end up in the same situation that we were talking about above. Again, I would favor, at this point, based on the literature, favor cricothyrotomy in those patients as well. You could consider, if the operator was skilled, using the lighted stylet to rapidly place it or digitally intubating or something. Whatever technique you use, you would have to be certain not to disrupt the stability of the cervical spine which would effectively rule out laryngoscopic oral intubation.

Mr. Gunderson: This is going to be sticky, I think, no matter how we treat it. We just have to accept that. In an apneic patient who does not have massive maxillofacial injuries, Dr. Cobb has expressed a preference for cricothyroid access. Ron, what would you go with at this point?

Mr. Johnson: I believe I'm going to have to back up Dr. Cobb. We just revised our protocol in the last month, and that's basically the way we're leaning right now. Even the other ambulance service in the county is going that way. They're doing a modified trans jet, but we're still —

Dr. Nelson: Your paramedics are going to be cutting people's necks in the field?

Mr. Johnson: Yes, sir. The medical director is going to be coming out doing the actual training in about two weeks. We've got the protocols out for them to read. We're having mandatory meetings next week, and then he and the director will be coming out in about two weeks with actual training.

Mr. Gunderson: If you didn't do a cricothyroid, which approach would you take, Dr. Nelson? Obviously you don't agree with the cricothyroid. Which approach would you use in this patient?

Dr. Nelson: I don't disagree with cricothyroid. Surgical cricothyrotomy. My second choice of the cricothyroid routes would be a retrograde intubation, in this case using a guide wire.

Dr. Cobb: That's reasonable.

Dr. Nelson: My third choice, avoiding the cricothyroid route — let me add, I would not do trans-tracheal jet in any way — would probably have to be blind-lighted stylet intubation or the PTL.

Mr. Gunderson: Tactile oral?

Dr. Nelson: I'm not sure.

Mr. Brown: I would like to point out here, as far as the pharyngeal airway, the American College of Surgeons' Adv*anced Trauma Life Support* text does recognize that nasal airways can be placed in the head-injured patient. Once the tip is visualized in the oral airway or rather in the pharynx, you can safely pass suction catheters or NG tubes. The construction of nasal airways is very different from that of the harder PVC suction catheters or Levine tubes. Being soft and having a pre-curvature, they can be placed safely. I would emphasize you must visualize the tip protruding from the nasopharynx into the pharynx.

Dr. Cobb: Well, I think in the hospital situation, yes, but in the field situation where it's often difficult to visualize anything, you may not have really adequate suction. You may have darkness to contend with and so on. Nasal instrumentation is probably just best avoided entirely. I think that in the patient without facial injuries, the PTL or these other devices are perfectly appropriate. But in the patient with facial injuries, I still think the preponderance of the literature would support cricothyrotomy as the first airway measure.

Mr. Gunderson: Okay. These look very much the same, the only difference is we have blind nasal over here.

Mr. Scarberry: Mic, I think we also, out of fairness to your apneic category, you have to add EGTA because when you don't have facial trauma, it is a legitimate device.

Airway Support of Non-Trauma Cases

Mr. Gunderson: So we now have a patient who needs an airway, is inadequately ventilated or is apneic, but does *not* have trauma. We're looking at more of the typical medical cardiac arrest victim. What are our steps there? Reflecting on our trauma sequence, would a pharyngeal airway be our first step?

Dr. Nelson: I would also have to include the PTL because I think it's probably just about as fast to put that in as it is to slip a standard oral airway in.

Mr. Scarberry: Our current times are about 15 to 20 seconds.

Dr. Cobb: I think that's probably accurate, especially if you use a tongue blade to place the oral airway. You're probably talking about the same length of time. And actually with this device you then would have a definitive airway as opposed to temporizing. So actually there might be some advantage to doing it that way.

Mr. Gunderson: Suction.

Dr. Cobb: Yes, suction.

Mr. Gunderson: And now we're going to ventilate with BVM or the mechanical ventilator.

Dr. Cobb: Either.

Mr. Brown: Since the pharyngeo-tracheal lumen airway is mentioned in the non-trauma patient, are there any studies with the pharyngeo-tracheal lumen airway that looked at the patient that needed ventilatory support and an airway device, but were somewhat responsive? I ask this because cases such as the COPD patient and the CHF patient that require aggressive ventilatory support can tolerate a nasally introduced tube.

Mr. Scarberry: If he can tolerate an oropharyngeal airway he can probably tolerate a PTL. But a nasopharyngeal airway is more likely to be tolerated by a patient with a higher level of consciousness. If there's an intact gag reflex, the PTL is contraindicated.

Mr. Brown: We do have the option of administering oral cavity and pharyngeal anesthesia - topical anesthesia - for the same patients.

Dr. Cobb: If you're doing a blind nasal technique, for example, I think using a topical vasoconstrictor and a topical local anesthetic is reasonable.

Mr. Brown: However, with a congestive failure patient, I would tend to go ahead and use the endotracheal tube rather than the pharyngeo-tracheal lumen airway.

Dr. Cobb: Right. Well, you can entirely bypass using the pharyngeal airway by placing the nasotracheal tube partially into the nasopharynx, but not yet advancing it into the larynx, and then administer oxygen through that and use that as an oxygen administration device.

Mr. Gunderson: Essentially use a partially inserted nasal endotracheal tube as a nasopharyngeal airway.

Dr. Cobb: Right, pending definitive placement of the tube. So you actually begin administering oxygen into the patient's airway before the tube is placed in the trachea.

Mr. Gunderson: So it would still be a pharyngeal airway, that would be just an option instead of using a specific device.

Dr. Cobb: Right. But, I would say that the PTL should be reserved for the obtunded patient. In the conscious patient I think it really should not be used. And in that case one should go either with an oropharyngeal or a nasopharyngeal airway or an endotracheal tube.

Dr. Nelson: You can't use an oropharyngeal airway in a conscious patient anyway.

Dr. Cobb: Right, a nasopharyngeal airway.

Mr. Scarberry: Right.

Dr. Nelson: Neither.

Dr. Cobb: Nasopharyngeal airways? - Actually, I've seen people tolerate them.

Mr. Scarberry: A nasopharyngeal will work on a semi-intact gag reflex; the oropharyngeal airway will not work.

Mr. Brown: That's the chief reason for its popularity is that it is much more easily tolerated in the patient that falls into that gray area between fully unresponsive and fully responsive. And we've seen that fully responsive patients can also tolerate it.

Dr. Cobb: But that's why I think just going ahead and placing the nasotracheal tube gives you an advantage because you can administer oxygen while securing the airway.

Mr. Gunderson: Now, the only thing that remains is for the case in which we're not using the PTL is now providing a more definitive airway beyond the pharyngeal airway. Would it would be appropriate to simply say the non-surgical intubation methods since there's no trauma?

Dr. Cobb: Oral or nasal tracheal intubation.

Mr. Gunderson: And simply leave it at that?

Dr. Cobb: By whatever means are appropriate.

Mr. Brown: Again, direct laryngoscopy is the preferred method, whether it's an oral or a nasal tube simply because of the speed and the sureness —

Dr. Cobb: In the unresponsive patient.

Mr. Brown: — and the lack of — or the ability to avoid blunt trauma to those delicate structures.

Dr. Cobb: In the unresponsive patient.

Mr. Scarberry: I like that because that's the correct statement. The preferred method at that stage is direct visualization. So oral or nasal direct visual intubation, and then second, backup mode, is tactile, lighted stylet, and all the rest.

Dr. Nelson: Or the indirect methods.

Mr. Scarberry: Okay. Thank you.

Mr. Gunderson: Or indirect if difficult.

Mr. Scarberry: Right.

Mr. Gunderson: Does everybody feel comfortable with this (referring to notes on the board)?

Mr. Scarberry: I would add two more legs on your last statement. If indirect is difficult, you would still go with an EGTA or PTL. Those would be your other modes in advanced care.

Mr. Gunderson: Comments?

Mr. Brown: Difficult intubations have to do with one of two things, one of which is patient responsiveness and combativeness, and the other is difficulty in visualization or in blind placement.

Mr. Gunderson: Let's assume that we've done the procedure properly, and we've given them their topical anesthesia, so —

Mr. Brown: The point being is that if the intubation were difficult because of patient combativeness, that doesn't seem to be an indication for placement of an esophageal obturator airway.

Obstructed Airway: Non-Trauma Cases

Dr. Nelson: If you're dealing with a complete upper airway obstruction, your method of choice is, barring basic life support procedures to clear that obstruction, cricothyroid surgical management - cricothyroid puncture surgical. I'm talking about in the non-trauma patient.

Dr. Cobb: If you're unable to ventilate the patient after the pharyngeal airway or PTL is placed, I think is what he's getting at there. If you're unable to ventilate the patient at that point, then more than likely you're dealing with upper airway obstruction, and you should proceed either to airway clearing maneuvers and failing that to surgical airway.

Mr. Scarberry: Would you not want to visualize it before you went to surgical airway?

Dr. Nelson: That takes too long. You don't have that kind of time. You don't have that kind of time to sit there and try to visualize something.

Dr. Cobb: Especially in a patient who may be struggling.

Mr. Brown: Then, again, some textbooks say that the inability to ventilate calls for the immediate examination by laryngoscopy of the glottis.

Mr. Gunderson: With the Magil forceps in your hand.

Dr. Cobb: Again, I think that depends on the patient's status. It is a matter of clinical judgment. If you have a patient who's struggling and obviously becoming hypoxic but still struggling, trying to laryngoscope a patient like that is going to be exceedingly difficult. And administration of sedation or neuromuscular blocking drugs to that patient is fraught with hazard and most foolish.

Dr. Nelson: What do you do if you come at them with a knife?

Dr. Cobb: You get enough assistance and you hold them down.

Mr. Brown: Then a point of clarification. If you have an apneic, profoundly obtunded or flaccid patient, and you insert an oral or a nasal airway and then attempt to ventilate and find very low compliance, then the immediate maneuver should be laryngoscopy.

Dr. Cobb: Laryngoscopy is reasonable in that case, but in the patient who is struggling, laryngoscopy is almost impossible. And take it from me, I've tried it.

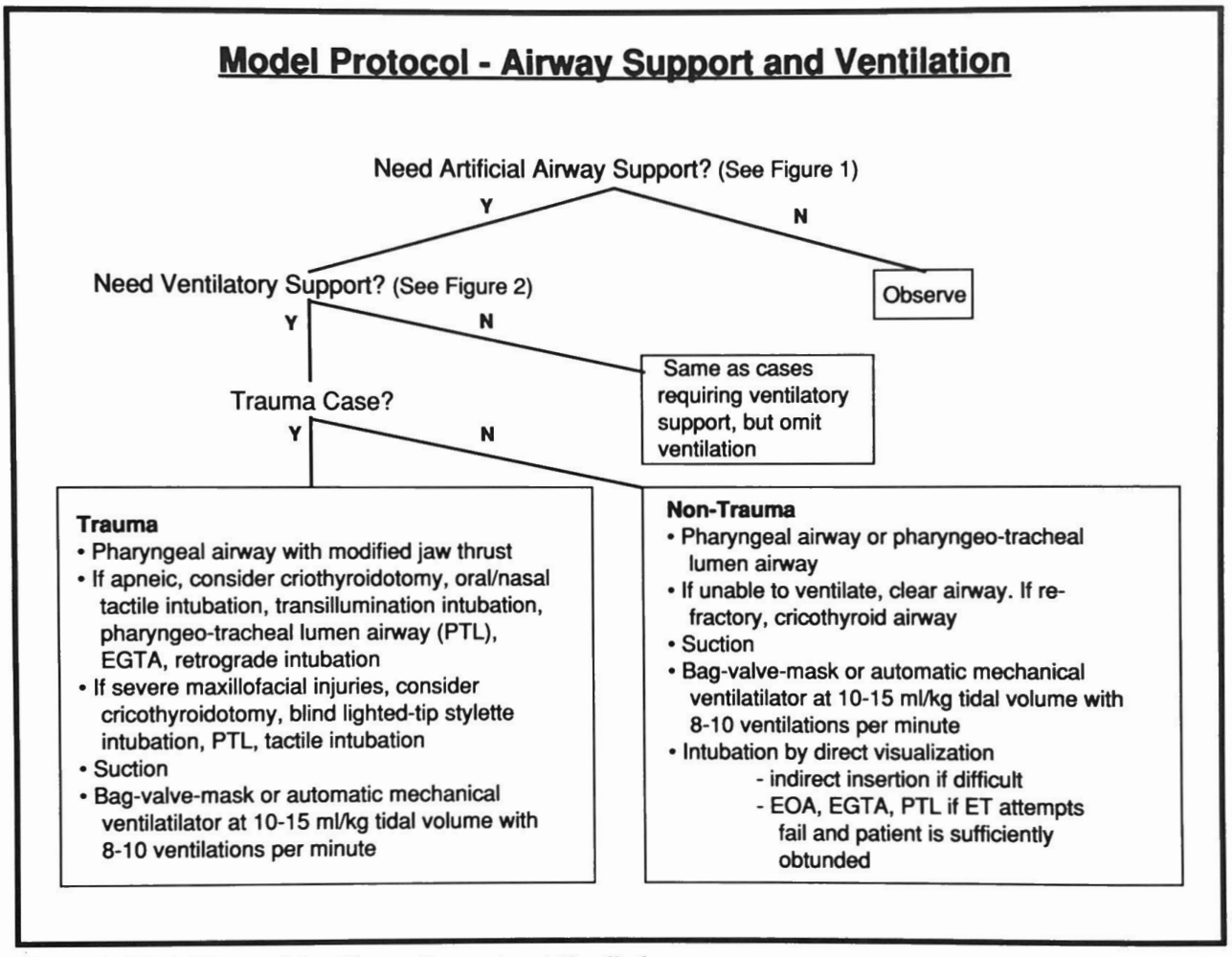

Figure 4 - Model Protocol for Airway Support and Ventilation

Mr. Brown: And I fully agree.

Dr. Nelson: That would fit under the "clearing the airway." You could try basic life support or laryngoscopy procedures to clear the airway. But the definitive treatment for obstructed airway that remains obstructed is going to have to be cricothyroid access.

Mr. Gunderson: So if they are refractory to whatever means are employed to clear the airway, which could be a whole separate sequence, then we go to the cricothyroid.

Mr. Brown: I would like to briefly solicit opinions on this point. When you have persons who are trained in laryngoscopy and you have a patient that you are unable to ventilate, should one go initially with the airway maneuvers described under basic life support, or should one proceed immediately to the laryngoscopy? I've seen both opinions written in the textbooks.

Mr. Gunderson: I, myself, I've gone directly to the laryngoscopy rather than the artificial cough if they're unconscious. If they're still struggling, then I'll —

Mr. Brown: Again, I'm referring to the profoundly obtunded patient.

Mr. Gunderson: Profoundly obtunded patient - I usually go with the laryngoscope.

Dr. Cobb: I think I would go with a laryngoscopy at that point, too, particularly in the adult. The object is most likely to be obstructing at the level of the vocal cords because that's the narrowest point of the upper airway, and so you're probably going to be able to visualize it and remove it. But in the patient who is struggling, again, I think that the other measures have to be used.

Mr. Gunderson: Again, assuming that you've got your laryngoscope and forceps immediately available. It certainly is not the type of situation where you would want to have your partner go back to the truck and get it.

Dr. Cobb: No, in that case you proceed with the BLS maneuvers.

Mr. Gunderson: Was there something else we had underneath the oral or nasal intubation by direct visualization?

Dr. Cobb: Mechanical ventilation.

Mr. Gunderson: We've already done that.

Mr. Scarberry: My comment was if difficult, the third fallback would be EGTA or PTL, because that's the backup.

Dr. Cobb: For failed intubation attempt. Again, with the caveat that that is to be in the unresponsive patient. A failed intubation attempt in the conscious patient would necessitate different management, administration of supplemental oxygen primarily, using an alternate method.

Mr. Brown: Preparing them with adequate topical anesthesia and/or the administration of analeptic agents.

Dr. Cobb: I personally am opposed to the use of neuromuscular blockade by personnel who aren't trained extensively in airway management.

Mr. Gunderson: That is an entirely separate issue beyond the scope of this discussion. That's a protocol for a specific intubation procedure.

Ventilation

Mr. Gunderson: The only point at which they (trauma and non-trauma cases) would come back together is in what we would use for ventilation. We're using BVM right now. Would we go to something else later on?

Dr. Cobb: I would say BVM, then consider mechanical ventilation.

Mr. Walters: *(Cline Walters, Aero Products; Longwood, FL)* Could you not consider the mechanical ventilation up there in the beginning?

Dr. Cobb: The problem is once you've instituted bag valve mask ventilation, I think it's best to continue with that until you've secured the airway and then change your modalities. To change your modality of ventilating the patient in the middle of trying to establish an airway, to me, would be unwise. I would wait until the definitive airway has been established, put the patient on the ventilator, and then go about the remaining tasks.

Mr. Walters: Certainly. But most of the newer ventilators also have BLS as well as ALS application. They can be used very similar to a bag valve mask.

Dr. Cobb: They can be. In general, the bag-valve-mask is more portable, easier to deploy, and requires less manipulation at the scene in say in a crashed car or in a ditch or something. You want to go with the simplest equipment you have at that moment.

Mr. Scarberry: And it may give you some tactile feedback.

Dr. Cobb: I think there's definitely a place for mechanical ventilation in these patients, but I would prefer — Joe, how do you feel about that? I would prefer to wait until the airway is definitively established.

Dr. Nelson: I would like to see mechanical ventilation be limited to those cases where an endotracheal tube or some other direct tracheal access is gained. That also doesn't rule out the use of the demand valve.

Mr. Walters: Let me bring up a couple of points. An inherent problem with bag valve resuscitators is having one hand used to squeeze the bag and the other hand being used to maintain the seal. If the automatic ventilator is carried in a small enough kit and is accessible, you can have a two-handed mask seal operation versus only one hand on the bag and one hand on the mask. So with the advantage you're going to gain there in time with the bag-mask, which may only be a matter of one or two seconds with the way some people have their kits set up, you're going to lose gas with mask leakage due to a one-handed seal method. Whereas, once you've got your automatic ventilator set up, you have two hands free to maintain that mask seal. I just throw that out as a consideration because tidal volume and rate can be controlled more accurately by the automatic ventilator, rather than with the human element of squeezing the bag.

Mr. Gunderson: It seems to be an ergonomic problem.

Mr. Brown: You're in a manpower poor environment when we're talking about the prehospital arena. Not always true if you have an adequate number of responders, but then you run into how skilled are your extra responders. So Cline has a very good point there - it (automatic ventilator) can be an aid in the manpower poor environment.

Mr. Gunderson: Assuming the ventilator is right there with you in your jump equipment, you just turn it on, he can use both hands to hold the seal rather than one hand on the mask, one hand on the bag.

Dr. Cobb: I have no major objection to it. We could put as an alternate —

Mr. Walters: Either/or.

Dr. Cobb: — consider mechanical ventilator at that point.

Dr. Nelson: However, I would like to interject that I don't think that any sort of mechanical device can be 100 percent dependable here. There should always be a backup.

Mr. Walters: Absolutely.

Dr. Nelson: But I don't have any problem with the mechanical ventilators.

Mr. Gunderson: Do we want to specify our tidal volume recommendation and a ventilatory mode?

Dr. Cobb: Use a 10 to 15 ml per kilogram tidal volume with a rate of 8 to 12 breaths per minute in the adult.

Mr. Gunderson: We're only talking about the adult.

Dr. Nelson: I would agree with that.

Mr. Gunderson: It looks like we have a ventilated trauma patient with a definitive airway.

(See Figure 4 regarding the model protocol)