

Respiratory Care Controversies II

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Summary

Despite a plethora of publications on the art and science of respiratory care, a number of basic issues remain unanswered. These clinical controversies are often settled by expert opinion and personal bias. By definition, a controversy has compelling arguments for each side of the issue. This RESPIRATORY CARE Journal Conference addressed 12 clinical controversies, ranging from spirometry screening for chronic lung disease to the timing of tracheostomy. This paper is a concise synopsis of the salient points of each side of each argument and provides the points of consensus and points of contention. When appropriate, further research is suggested to address still unanswered questions. *Key words: respiratory; controversy; spirometry; smoking; steroids; acute respiratory distress syndrome; acute lung injury; extubation; polysomnography; tracheostomy; mechanical ventilation; prone positioning; inhaled vasodilators; esophageal pressure; pressure-targeted ventilation; lung-protective ventilation; endotracheal tube; heat-and-moisture exchanger; ventilator-associated pneumonia; spontaneous breathing trial; noninvasive ventilation; humidification.* [Respir Care 2010;55(2):217–224. © 2010 Daedalus Enterprises]

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Introduction

Respiratory Controversies II is the Journal's second foray into a pro/con debate format to explore the poles of particular issues. By presenting unyielding arguments at extremes of the debate, pointed and often heated discussions ensue, followed by more thoughtful discourse, and ultimately agreement on some basic tenets. In the previous Controversies Journal Conference¹ only critical care topics were discussed. This controversies conference covered ambulatory care, critical care, decision making, and equipment. The papers and discussion from this conference are as enlightening as were those of the first controversies conference.

Is There a Role for Screening Spirometry?

MacIntyre and Selecky tackled the difficult issue of the wisdom and outcome of performing spirometry in all smokers.² Disease from cigarette smoking remains a serious public health issue, and, at first blush, testing all smokers for lung disease appears a noble cause. Selecky impressed the group with statistics on chronic obstructive pulmonary disease (COPD) and smoking. COPD occurs in approximately 7% of the population, is the fourth leading cause of death worldwide, and the smoking-related mortality in women has doubled in the past 20 years. Compared to cardiovascular diseases, which have had a steady mortality decline over the last 30 years, the age-adjusted death rate from COPD in the United States has risen 163%. Selecky argued that, while the current guidelines that lead to spirometry testing include symptoms (cough, sputum production, and shortness of breath) and exposure risk factors (smoking, occupational, indoor/outdoor pollution), testing in the absence of dyspnea is warranted. Early detection and treatment, including smoking cessation, would reduce morbidity and mortality.

MacIntyre switched the argument to the practical. Chief among his objections to screening spirometry for smokers was the simple fact that all smokers should be encouraged to quit, regardless of the spirometry findings. The only successful therapy is smoking cessation, so spirometry is an unnecessary step. Issues related to spirometry quality-control and interpretation were reviewed. The actual costs were debated, with special reference to the costs associated with false positive results. A particular clinical conundrum arises when the smoker has a normal spirogram. Would a normal result encourage the patient to continue to smoke? While other smoking risks, such as cancer and heart disease, continue, the normal spirogram could be a potential impediment to smoking cessation.

Several areas of contention were simplified, including who to screen with spirometry, where to conduct the spirometry, who conducts the spirometry, spirometry quality-control, and what to do with the results. While the original

topic was presented as a single question, the group requested that the issues be subdivided for voting. The first statement, "Spirometry should be done in all subjects," was unanimously defeated (13 to 0). The second statement, "Spirometry should be done in all smokers," resulted in 4 affirmative and 9 negative votes. Finally, the statement, "Spirometry should be done in all symptomatic smokers," was unanimously yes.

Are Corticosteroids Useful in Late-Stage Acute Respiratory Distress Syndrome?

Sessler and Gay debated whether steroids are useful in late-stage acute respiratory distress syndrome (ARDS).³ This controversy continues despite a growing body of evidence from clinical trials. The most recent study by the ARDS Network found that methylprednisolone was associated with significantly higher 60-day and 180-day mortality in patients enrolled ≥ 14 days after the onset of ARDS. However, methylprednisolone increased the number of ventilator-free and shock-free days during the first 28 days, improved oxygenation and respiratory-system compliance, and was associated with fewer days of vasopressors for hypotension. Compared to placebo, methylprednisolone did not increase the rate of infectious complications but was associated with a higher rate of neuromuscular weakness. The ARDS Network concluded that the routine use of methylprednisolone for persistent ARDS is not recommended, despite the improvement in cardiorespiratory physiology variables, and warned that starting methylprednisolone more than 2 weeks after the onset of ARDS may increase the risk of death.⁴

Those most recent data were the starting point for both sides of the argument. It was suggested that the improved physiologic variables are yet another example that there is no substitute for survival as the primary outcome variable. However, the improvement in gas exchange with methylprednisolone might assist in reducing the risk of ventilator-induced lung injury by allowing lower ventilation pressures. Ventilator-free days favored the use of steroids, and the finding of fewer days on the ventilator is probably related to fewer infectious complications. The mortality increase associated with methylprednisolone after 2 weeks of ARDS may be related to dosing and tapering of the drug, not the drug alone.

Both Sessler and Gay discussed the issue of study enrollment. In the ARDS Network trial, over 4,000 patients were screened and 3,464 were eligible, yet only 180 (5%) were enrolled. On the con side, Gay pointed to the multiple trials of methylprednisolone that failed to show a survival benefit. He raised several issues related to the choice of steroid delivered, the dose, and timing of dosing. There was some discussion concerning the assumption that all ARDS is the same, and some questioned the idea that a

single therapy could be a “magic bullet” for ARDS. All agreed that magic bullets are few and far between.

The discussants re-framed the question in an effort to reach consensus and ascertain current practices, which resulted in 5 questions:

1. How many routinely use methylprednisolone in the treatment of persistent ARDS? Two of 13.
2. How many use methylprednisolone in selected cases of persistent ARDS? Eleven of 13.
3. How many never use methylprednisolone for persistent ARDS? Zero of 13.
4. How many have used methylprednisolone in the last 6 months for persistent ARDS? Six of 13.
5. How many believe another trial is necessary to answer the question? Thirteen of 13.

Steroids for late-stage ARDS remained as controversial after the discussion as before it. While many believe the role of steroids in late ARDS is answered by the ARDS Network trial, the voting proved not everyone had the courage of their convictions.

Should Patients Be Able to Follow Commands Prior to Extubation?

Moore and Epstein began the first of several discussions regarding the discontinuation of mechanical ventilation. They debated the importance of the patient's ability to follow commands prior to extubation.⁵ Epstein asserted that the patient does not need to be able to follow commands to be successfully extubated. He argued that the ability to follow commands is arbitrary and does not identify why the patient could or could not follow commands (eg, sedation vs delirium vs brain injury). Delay of extubation is associated with higher risk of ventilator-associated pneumonia (VAP), tracheal injury, longer intensive care unit (ICU) and hospital stay, higher mortality, and higher costs, so he thought that extubation of a patient unable to follow commands is warranted. Moore argued that the Glasgow coma score (GCS) can assist in deciding which patients to extubate. She presented data that with a GCS of ≥ 8 extubation is successful 75% of the time, compared to only 36% of the time when GCS is ≤ 7 . She introduced the idea that if a patient is unable to follow commands and the underlying etiology is unlikely to improve, then tracheostomy is the next logical step. If improvement is anticipated, waiting for the patient to be able to follow commands is warranted.

There was some discussion that the GCS can be misleading, depending on the Glasgow coma scoring system used. In an intubated patient the GCS can be 8 without the patient being able to follow commands. GCS can provide the patient a 1 for verbal, owing to the endotracheal tube (ETT) or attempt to assess the patient's ability to speak if

the tube were not present. Additional factors emphasized included peak cough flow. It was agreed that GCS was not the best score of mental status and that patients unable to follow commands should have sedation discontinued and a spontaneous breathing trial (SBT). The group voted 13 to zero that the patient did not have to be able to follow commands prior to extubation.

Are Sleep Studies Appropriately Done in the Home?

Gay and Selecky debated whether sleep studies are appropriately done in the home. The controversy surrounding polysomnography testing boils down to the issues of cost, convenience, and accuracy of results.⁶ The incidence of obstructive sleep apnea (OSA) is reportedly 2–4% of the middle-aged population, and OSA comorbidities, including hypertension, heart failure, and stroke, mandate that OSA be diagnosed and treated early. Gay presented data that the currently available portable polysomnographs can adequately record sleep events in the home and, compared to traditional sleep-laboratory polysomnography, are more convenient and less costly. He presented data that unattended home polysomnography and an auto-titrating continuous positive airway pressure (CPAP) system result in better patient adherence to CPAP, with no difference in other outcomes, compared to attended laboratory polysomnography.⁷

Selecky countered those arguments with a review of polysomnography myths. The first of these is that polysomnography laboratories are over-burdened and the long wait for a laboratory polysomnography puts patients at risk. He pointed to the exponential increase in the number of sleep laboratories and suggested that scheduling is not a serious barrier to obtaining a laboratory polysomnography. At present, portable polysomnographs cannot measure sleep stages, and some studies suggest that substantial amounts of sleep data are frequently lost during home polysomnography. Selecky also argued that politics and payment should not dictate patient care, that speed should not be prized over accuracy, and that the expertise offered by the sleep laboratory should be valued.

There was a universal agreement that OSA and other sleep disorders are an important public health issue and that any system that speeds early diagnosis and effective treatment should be supported. Portable polysomnographs and auto-titrating CPAP systems appear to offer some advantages in this regard. It was suggested that home polysomnography may be useful in patients with simple, uncomplicated OSA, but that traditional attended laboratory polysomnography remains important for the diagnosis of more complex disease or a combination of disorders. The final vote was based on the question, “If home polysomnography speeds testing and delivers CPAP to patients who need it, is it acceptable?” The panel voted unanimously in the affirmative.

Should Tracheostomy Be Performed as Early as 72 Hours in Patients Requiring Prolonged Mechanical Ventilation?

Durbin and Moores debated the controversy with the longest, qualified title, which is commonly described as the early versus late tracheostomy debate.⁸ This topic has been bantered about since the invention of the ETT, but recent changes in our understanding of VAP and the introduction of routine, bedside percutaneous tracheostomy has reframed the issue. Durbin began his discussion with the bold statement that “prolonged intubation is not better than tracheostomy—early or late.” Continued arguments for early tracheostomy in the patient expected to require ventilation of more than 2 weeks included;

- No study has ever favored late tracheostomy over early tracheostomy.
- Mortality has never been shown to be worse with early tracheostomy.
- For an equivalent duration of ventilation (7–10 d), tracheostomy has a better safety profile than translaryngeal intubation.
- Resource utilization is lower with earlier tracheostomy.

Durbin concluded that the question’s time frame of 2 weeks is too long, and that patients requiring ventilation for more than 1 week should have early tracheostomy: sooner is better.

Moores countered that, while there is a perception that the pneumonia rate is lower with early tracheostomy, evidence to support that view is lacking. While early tracheostomy has no impact on mortality, the complications of any surgical procedure have a finite complication rate, no matter how small. Regardless of the skill of the operator, tracheostomy carries an inherent surgical risk that must be balanced against an ill-defined possibility of benefit. Patient populations are a complicating factor in this discussion; head-injury patients seem to be ideal candidates for early tracheostomy, but the same claim cannot be made for all populations. Some discussion of the cosmetic effect of an unnecessary tracheostomy scar in younger patients without head injury ensued, with the acknowledgment that long-term patient preference may not coincide with early tracheostomy.

The early versus late tracheostomy debate is likely to persist and reemerge in future controversies symposia. Clearly, a large randomized controlled trial is required to definitively answer this question, and patients with head injury or other trauma need to be considered separately from those with primary pulmonary disease. While there was relative agreement that better studies are needed, there was little enthusiasm that these studies will be carried out. The group lacked equipoise on the issue. Several panelists

thought early tracheostomy was clearly preferable and that randomization to a late-tracheostomy group would be unethical. When the dust settled, 2 questions were posed and a vote was taken:

1. If you could predict that a patient would need mechanical ventilation for longer than 21 days, would you perform an early tracheostomy? Thirteen yes, zero no.
2. Can you predict that a patient will need mechanical ventilation for longer than 21 days during the first 3 days in the ICU? Zero yes, 13 no.

Thus, the group unanimously decided it would do something based on a prediction about a variable that it unanimously decided it could not predict.

Should Prone Positioning Be Routinely Used for Lung Protection During Mechanical Ventilation?

The role of prone positioning in ARDS was debated by Fessler and Talmor.⁹ Fessler presented the argument for prone positioning as a therapy that makes physiologic sense and that, under most circumstances, can be applied at little to no cost. Prone positioning recruits dorsal lung units and improves distribution of ventilation by altering the pleural pressure gradients, which improves gas exchange and may reduce the risk of ventilator-induced lung injury. He evaluated the recent publications on prone positioning in ARDS and assessed the problem that no study has demonstrated a mortality benefit. Methodological reasons were presented for that lack of success. He pointed out that in many of the studies the average time in the prone position was less than 8 hours a day. This was described as a problem of “under-dosing” (ie, not enough time per day in the prone position). The question was raised, if low-tidal-volume (low V_T) ventilation were applied for only 8 hours a day, would low- V_T ventilation have demonstrated a mortality benefit? In a recent meta-analysis the data seemed to favor prolonged application of prone positioning.¹⁰

Fessler also suggested that prone positioning had been applied to ARDS without regard for the underlying etiology or respiratory mechanics. In a patient with lobar collapse secondary to pneumonia the response to proning is probably quite different than in a patient with diffuse, dependent atelectasis following massive transfusion. Most proning studies have been both under-dosed and under-powered. Ancillary therapies such as low- V_T ventilation may also have impacted those studies. Fessler concluded that the ready availability and gas-exchange improvements of prone positioning make it a valuable adjunct to lung-protective ventilation.

Talmor conceded that prone positioning does have a rational physiologic basis and that improvements in oxygenation are commonly seen in selected patients. With respect to the literature, he was also quick to point out that,

while there were a host of methodological frailties in these studies, the only consistent finding was that proning did not alter mortality. Additional arguments against proning concentrated on the multitude of actual and potential complications. Both accidental selective endobronchial intubation and tube obstruction appear to be increased with proning. Another consistent finding is that the incidence and severity of pressure sores are greater in prone patients, which is probably due to the anatomical differences in the skin/surface interface, and the relative inexperience with nursing prone patients. Talmor did concede that in the most critically ill patients proning might have a mortality benefit, but concluded that routine use of proning is not supported.

The ensuing discussion resulted in a review of decision making by the bedside clinician. When randomized clinical trials support the use of a given intervention, the clinician must decide if their current patient is representative of the patients treated in those trials, and whether they have the resources and skill to implement those interventions safely and effectively. If the answer to both is yes, the intervention should be implemented. If the answer is no, then a further risk/benefit analysis is in order. Prone positioning continues to be plagued by questions surrounding the appropriate patients, “dose” (ie, hours per day in the prone position), and timing. The group was skeptical that a definitive trial of prone positioning is feasible. In the interim, the risks and benefits of proning will have to be assessed on a patient-to-patient basis. The statement, “Prone positioning should be used routinely” received a unanimous 13 no votes. When the group was asked who used prone positioning routinely in difficult-to-oxygenate patients, 4 voted positively and 9 negatively.

Are Inhaled Vasodilators Useful in Acute Lung Injury and Acute Respiratory Distress Syndrome?

Siobal and Hess debated the use of inhaled vasodilators in the management of acute lung injury.¹¹ Siobal provided an overview of inhaled vasodilators, including inhaled nitric oxide (INO) and aerosolized prostacyclins. Inhaled vasodilators have the important distinction of acting locally to produce selective pulmonary dilation, when delivered in appropriate doses. This selective vasodilation improves local ventilation-perfusion matching at low doses, and relieves pulmonary hypertension at high doses, without impacting systemic circulation. Siobal extolled the positive effects of inhaled vasodilators on oxygenation in ARDS, and particularly the role of INO in the resolution of refractory hypoxemia. Despite concerns over a failure to produce an outcome benefit in ARDS, INO reliably and reproducibly improves oxygenation over the first 24 hours of treatment. Siobal argued that during that period INO could provide the necessary time for primary treatments to resolve the underlying pathology, with INO acting as a bridge.

The role of INO and prostacyclins in the treatment of pulmonary hypertension and right heart failure was discussed, again emphasizing the importance of selective vasodilation and the lack of systemic effects. Siobal unveiled the “elephant in the room” with a review of INO’s costs. While Siobal stopped short of suggesting the routine use of INO and other inhaled vasodilators, he did reaffirm his support for their use in patients with refractory hypoxemia.

Hess concentrated his discussion on the lack of outcome benefit across a number of clinical trials, and the costs. He conceded that INO improves arterial oxygenation in a majority of patients with ARDS, but pointed out that a recent meta-analysis suggested an increased risk of renal failure and mortality in patients receiving INO.¹² Hess made some cogent arguments against aerosolized vasodilators. While INO has been tested in several large clinical trials, inhaled prostacyclin has not been subjected to anywhere near that magnitude of study. Aerosolized selective vasodilators are susceptible to all the shortcomings of aerosolized bronchodilators with respect to distribution and penetration. In fact, very little is known about the most effective methods to assure that aerosolized vasodilator delivery is consistent and prevents “spill-over” into the systemic circulation, whereupon the drug’s pulmonary selectivity is lost. Hess examined the cost issue further and agreed that, while aerosolized vasodilators are less expensive, neither INO nor inhaled prostacyclin has demonstrated an outcome benefit, so any cost/benefit analysis is moot. He demonstrated this in the following equations:

$$\text{Value} = \text{benefit/cost} = 0/\$137.50/\text{h for INO} = 0$$

$$\text{Value} = \text{benefit/cost} = 0/\$200/\text{d for prostacyclin} = 0$$

Further discussion expounded on the inequities of direct comparison of INO to aerosolized prostacyclin, and costs. It was agreed that aerosolized vasodilators do not have the same weight of evidence for safety and efficacy (improving oxygenation) as does INO. The group agreed that the oxygenation improvement with either INO or inhaled prostacyclin is “cosmetic” and that we should not be seduced by improvements in physiologic variables without outcome data. The vote was based on a clinical scenario. In a patient with ARDS on a plateau pressure of 40 cm H₂O, a fraction of inspired oxygen (F_IO₂) of 1.0, and a P_aO₂ in the 40s, how many would use INO? There were 7 yes votes and 6 no votes. All those who voted no said they would use another rescue therapy.

Are Esophageal Pressure Measurements Important in Clinical Decision-Making in Mechanically Ventilated Patients?

Talmor and Fessler debated the merits of esophageal pressure monitoring to guide ventilator therapy.¹³ The im-

petus for this topic was the recent paper by Talmor and his colleagues, published in the *New England Journal of Medicine*, which suggested an improvement in outcome associated with adjusting positive end-expiratory pressure (PEEP) based on esophageal manometry.¹⁴ Talmor suggested that the use of the ARDS Network PEEP/ F_{IO_2} table based on oxygenation fails to appreciate the wide variety of pulmonary mechanics in ARDS patients. It has long been held that ARDS secondary to pneumonia and ARDS secondary to trauma represent 2 quite different pictures with regard to pulmonary and chest wall mechanics. This is the oft referred to “lumper versus splitter” argument. Talmor opined that basing ventilator settings on a maximum airway pressure of 30–35 cm H_2O may leave large portions of the lung under-inflated and at risk for ventilator-induced lung injury from repetitive airway opening and closing. This suggests that measuring esophageal pressure to estimate pleural pressure and setting PEEP to achieve a target transpulmonary pressure allow for higher PEEP without over-distending lung regions that are already recruited. This individualized approach to ARDS management may be an improvement over the ARDS Network approach, which targets the average patient.

Fessler based his counterpoint on issues related to the accuracy of esophageal pressure measurement and the non-uniform changes in pleural pressure in heterogeneous lung disease. While esophageal pressure has been used to estimate pleural pressure in awake, upright normal subjects, the ability of esophageal pressure accurately to predict pleural pressure in a supine, mechanically ventilated patient with ARDS is unknown. One of the hallmark findings in ARDS is extreme inhomogeneity of disease in the parenchyma, so the pleural pressure gradient is variable across several dimensions. Fessler referred to “an inconvenient truth” regarding the use of esophageal pressure to guide ventilator settings: the variation in local time constants may allow the clinician to use a more aggressive PEEP strategy at the expense of substantial over-distention of non-dependent lung regions. The position of the esophageal catheter then can be misleading regarding regional differences in volume and pressure. He summed up his argument by noting: “Not everything that can be counted, counts.”

A wide variety of opinions regarding the role of esophageal manometry in guiding ventilator settings ensued, and many of the participants reported using esophageal pressure measurements to teach fellows and examine specific teaching points. Only Talmor used esophageal pressure monitoring routinely. The final question came down to the concept of protocolized ventilator settings versus individualized settings. A vote ascertained how many of the panel would use a technique like esophageal pressure monitoring to individually guide the setting of PEEP, compared to a PEEP/ F_{IO_2} table. Five participants voted that they would

use an individualized approach, and 7 voted they would not. Further discussion concluded that these techniques should be used only by experts with the required training.

Are There Benefits or Harm From Pressure Targeting During Lung-Protective Ventilation?

MacIntyre and Sessler tackled the question of using pressure-controlled versus volume-controlled modes to provide lung-protective ventilation.¹⁵ The volume-control versus pressure-control controversy is an old one and has staunch supporters on both sides. Despite some arguments about terminology, the group agreed that the 2 important breath schemes are volume-targeted and pressure-targeted. Both breath types have been used to provide lung-protective ventilation. Volume-targeting guarantees a set V_T and minute ventilation, but, owing to the fixed flow, can result in patient-ventilator dyssynchrony. Volume-targeting does not limit the peak inspiratory pressure, and the highest pressure does not occur until the end of inspiration. In contrast, pressure-targeting limits the peak inspiratory pressure and uses a variable flow, which can reduce patient-ventilator dyssynchrony, but often at the cost of loss of V_T control. While pressure-targeting controls the peak inspiratory pressure, it allows the patient to dictate the V_T , which can exceed the target 6–8 mL/kg.

MacIntyre extolled the virtues of limiting peak inspiratory pressure and maximizing patient comfort during pressure-targeted modes. He suggested that pressure-targeting may reduce the need for sedation and therefore reduce the duration of ventilation. MacIntyre presented data demonstrating adequate control of V_T during both volume-targeted, pressure-targeted, and adaptive-support breaths.¹⁶ Sessler reviewed the data on comparisons of the 2 breath schemes and pointed out that there are no known outcome differences. He also presented data that suggest that when the V_T is too large, there is no safe plateau pressure.¹⁷

There was agreement among the faculty that pressure-targeting does seem to improve comfort, but that this may be a result of allowing the patient to obtain a V_T outside the lung-protective range. Two questions were posed to the group:

1. Do you use pressure-targeted breaths routinely to treat ARDS? Three of 11 (we lost a few panelists on the final day) routinely used pressure-targeting, and 8 did not. Those 8, however, said that they “sometimes” switch to a pressure-targeted mode to improve patient-ventilator synchrony.
2. What is the default breath type at the initiation of ventilator support in the patient with ARDS? Two panelists said they start with pressure control as the default breath type. The other nine said they start with flow/volume control.

The group agreed that it is the clinician's responsibility to maximize the benefits and minimize the adverse effects of any therapy. In what was a theme of the conference, the group espoused that it is the expertise of the operator rather than the features of a given device or mode that impacts outcome.

Are Specialized Endotracheal Tubes and Heat-and-Moisture Exchangers Cost-Effective in Preventing Ventilator Associated Pneumonia?

Siobal and Gentile turned the attention to devices and debated the relative merits of specialized ETTs and heat-and-moisture exchangers (HMEs) on the incidence of VAP.¹⁸ The specialty ETTs include silver-coated ETTs, polyurethane cuffs, and subglottic suction tubes. VAP is a common and serious complication of mechanical ventilation, and the recent suggestion that VAP should be a "never" event has placed enormous pressure on the ICU team. There is no doubt that VAP contributes to health-care expenses, morbidity, and, in some cases, mortality. Ways to prevent VAP beyond the VAP bundle may include the use of specialized artificial airways and different humidification devices. Siobal reviewed the data on the individual specialty ETTs, which demonstrate reduced airway colonization and less early VAP with each of the devices. The tubes use various methods to reduce silent aspiration or biofilm build-up to limit the impact of aspiration. As in any discussion of equipment, the issue of cost was scrutinized. Siobal emphasized that the cost of any of the individual devices paled in comparison to the cost of a single VAP. A review of the data comparing HMEs to heated humidifiers was less conclusive. Clearly, the main advantage of an HME is the low cost and elimination of condensate.

Gentile reviewed the technical and practical challenges of using these specialty ETTs. Subglottic tubes may be prone to occlusion and require special attention. The cost of silver-coated and polyurethane tubes may preclude use in all patients. Gentile's main concern was the practical implementation. Will these specialty tubes be used in all patients, or just the high-risk patients? Will emergency medical service personnel use these tubes, or will they be available only in the ICU and emergency department? Perhaps most difficult of all, would anyone consider removing a traditional ETT to replace it with a specialty tube in a patient at high risk of VAP? Gentile suggested that the hallmark of VAP prevention is a VAP bundle that works.

Gentile addressed the HME issue and recent meta-analyses that indicated no difference in VAP rate between HME and heated humidifier.

The discussion regarding the specialty tubes was brisk, and the issue of cost never far from the forefront of concerns. There was agreement that the unfounded concept

that a filter at the airway reduced VAP seems to have been put to rest. The question asked was, "How many use specialty tubes routinely?" All 11 participants did not use specialty ETTs routinely, but all would consider use in high-risk patients where traditional bundles proved ineffective.

Should a Patient Be Extubated and Placed on Noninvasive Ventilation After Failing a Spontaneous Breathing Trial?

Epstein and Durbin debated the merits of extubating a patient who fails an SBT and using noninvasive ventilation (NIV) to bridge the patient to spontaneous breathing.¹⁹ This concept has been studied with a small number of patients, mostly patients with COPD. Conceptually, the improved outcomes and reduced VAP associated with NIV could be applied to patients who initially required emergency intubation. Removal of the artificial airway improves communication, reduces VAP risk, and allows for less sedation. Epstein explained that up to 35% of mechanically ventilated patients fail their initial SBT. In patients who fail an SBT, 40% of the total time on mechanical ventilation is spent in the weaning phase; 60% in COPD patients. Several times in this conference it was shown that the longer the duration of mechanical ventilation, the greater the complications and mortality. Epstein was quick to point out that the cohort of patients most likely to benefit from this strategy is COPD patients. There is a growing body of evidence that in COPD patients NIV may reduce the duration of invasive mechanical ventilation, decrease complications, and reduce mortality, compared to weaning from invasive ventilation.

Durbin, who is a critical care anesthesiologist, focused his arguments on the risks associated with loss of the airway and the higher mortality associated with re-intubation. He returned to previous issues discussed in the conference, suggesting that to be extubated from invasive ventilation and placed on NIV, the patient must be able to follow commands, have limited secretions, and have an effective cough. Durbin questioned how these factors would be judged with a modicum of success. He described scenarios in which the airway is intentionally removed and then, with the patient in distress, the re-intubation of a difficult airway.

The discussion focused on specifics. Early extubation to NIV should be used in patients with reversible lung disease (eg, acute-on-chronic respiratory failure), good mentation, an effective cough, and minimal secretions. It was unanimously agreed that extubation to NIV must take place in a highly monitored environment, a clinician skilled in difficult-airway management should be present, and the patient should be capable of 5–10 min of spontaneous breathing to allow for interface adjustments. Finally, the

team must agree on what constitutes an NIV failure and must be willing to re-intubate without delay. The group voted on the question, "How many would extubate a COPD patient to NIV?" There were 4 affirmative and 7 negative responses.

Is Humidification Always Necessary During Noninvasive Ventilation in the Hospital?

Gentile and I addressed NIV humidification in the hospital. Humidification during invasive ventilation is a standard of care, required to replace the normal heat and humidification mechanisms of the upper airway.²⁰ During NIV the upper airway is intact, but the high flow and dry gas can tax the upper airway. I explained that the presence of leaks (which create unidirectional flow), supplemental oxygen, and high minute ventilation all push the isothermic saturation boundary down the tracheobronchial tree. The high flow and low humidity can increase airway resistance and reduce V_T for a given pressure. Drying of secretions may also result in NIV failure secondary to secretion retention, and then complicate re-intubation. I argued for heating and humidifying the gas to reduce these complications and improve the potential success of NIV.

Gentile countered that there have been no head-to-head comparisons demonstrating the superiority of either technique, so the additional cost and complexity of a heated humidification system cannot be justified. He made strong arguments that HMEs should never be used during NIV because of the greater dead space and higher work of breathing imposed by the HME. When NIV is successful, usually over a short duration, humidification would be unnecessary.

The group discussed the merits, cost, and complexity of NIV humidification, and 2 questions were posed:

1. Should heated humidification be used during NIV in the hospital? Nine voted yes. Two voted no.
2. Should heated humidification be used during home NIV? Eleven voted yes. Zero voted no.

A major unresolved issue was the level of heat and humidification that should be applied.

Summary

The second controversies Journal Conference proved that this method of pro and con debate allows a full review of the topics and, when possible, consensus on major issues. As always, this conference raised important unanswered questions and thus provides a road map for future research.

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