CRITICAL CARE ALERT®

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INSIDE

Safer Suctioning with Pressure Support

ABSTRACT & COMMENTARY

In this study, the effect of endotracheal suctioning-induced alveolar derecruitment was studied. The study population consisted of 9 sedated and paralyzed patients with acute lung injury. Five endotracheal suction techniques were compared in random order in each patient, with at least 30 min between each: 1) suctioning after disconnection from the ventilator; 2) suctioning without disconnection, introducing the suction catheter through the swivel adapter of the catheter mount; 3) suctioning with a closed suctioning system; 4) suctioning through the swivel adapter while triggering pressure-supported breaths at a peak inspiratory pressure of 40 cm H_2O; and 5) suctioning with a closed suction catheter while triggering pressure support at a peak inspiratory pressure of 40 cm H_2O during suctioning.

Trigger pressure on the ventilator was set at -1 cm H_2O during pressure support. The suction catheter (14 French) was inserted into the airway until resistance was met and then pulled back 2 cm. Intermittent suctioning was started while the catheter was gradually removed. Each suctioning maneuver lasted 25-30 s. Negative pressure was set at -200 cm H_2O (150 mm Hg). Changes in end-expiratory lung volume were measured by inductive plethysmography. The end-expiratory lung volume change was calculated as the difference between the volumes measured at the end of expiration just before and at the end of each suctioning procedure. SpO_2 changes were calculated as the difference between the value before suctioning and the minimum value recorded up to 1 min after each suctioning procedure.

End-expiratory lung volume after disconnection fell more than with the other techniques (-1466 ± 586, -733 ± 406, -531 ± 228, -168 ± 176, and -284 ± 317 mL after disconnection, through the swivel adapter, with the closed system, and with the 2 latter techniques and pressure support, respectively, $P < 0.001$). Recruitment decreased after disconnection and using the swivel adapter (-104 ± 31 and -63 ± 25 mL, respectively) was unchanged with the closed system (-1 ± 10 mL) and increased when using pressure support during suctioning (71 ± 37 and 60 ± 30 mL) ($P < 0.001$). Oxygenation paralleled lung volume changes. Maggiore and col-

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leagues concluded that suctioning-induced alveolar derecruitment in acute lung injury can be minimized avoiding disconnection prevented by using pressure support at a peak inspiratory pressure of 40 cm H_2O, which serves as a recruitment maneuver during suctioning. (Maggiore SM, et al. *Am J Respir Crit Care Med.* 2003;167:1215-1224.)

COMMENT BY DEAN R. HESS, PhD, RRT

Endotracheal suctioning is a necessary component of the care of mechanically ventilated patients. However, it is associated with complications, the most common of which is hypoxemia. Suction-related hypoxemia is likely related to alveolar derecruitment during the procedure in patients with acute lung injury. Cereda and associates previously reported that lung volume changes during suctioning can be ameliorated by use of closed suction.[1] Until recently, a focus of closed suction technique has been the avoidance of suction-related hypoxemia. However, suction-related hypoxemia may be the symptom of larger issue. Indeed, hypoxemia resulting from suctioning can often be avoided by simply increasing the FIO_2 setting on the ventilator. It is now widely accepted that alveolar derecruitment and subsequent rerecruitment (closing and re-opening) is a form of ventilator-induced lung injury. Thus, avoiding derecruitment (and associated hypoxemia) during suctioning should be considered part of a lung-protective ventilation strategy. In fact, I routinely use closed suction in mechanically ventilated patients with acute lung injury.

In this study, alveolar derecruitment was essentially eliminated if pressure support at a peak inspiratory pressure of 40 cm H_2O was used in conjunction with closed suction. With this clever technique, the ventilator is triggered when suction is applied and a pressure of 40 cm H_2O is applied for the duration of the suction maneuver. This achieves at least 3 potentially beneficial effects. First, positive end-expiratory pressure is not removed because the patient is not disconnected from the ventilator. Second, the ventilator servo-controls flow to maintain a constant airway pressure during pressure support (or pressure control). Thus, the application of suction aspirates flow (and volume) from the ventilator circuit (which is immediately replenished) rather than from the distal lung. This has been previously demonstrated in my laboratory.[2] Third, the application of 40 cm H_2O to the proximal airway serves as a recruitment maneuver during the suction procedure. One might envision the suction procedure removing airway plugging and the 40 cm H_2O recruiting collapsed alveoli distal to the previously obstructed airway. Although this technique was studied during a routine suction maneuver in this study, it begs the question of whether such a maneuver might also be beneficial during bronchoscopy.

This study provides additional evidence of the benefits of closed suction catheter use. Another benefit related to the use of a closed suction technique is a decreased risk of nosocomial pneumonia, and this should be considered part of a strategy to reduce the incidence of ventilator-associated pneumonia.[3] However, there remains considerable resistance among some clinicians to the use of closed suction catheters. It has been argued that closed suction is less effective at removal of secretions than open suction, but this has been reported *not* to be true.[4] Some have cited the cost of closed suction catheters as an obstacle to their use. However, these catheters do not need to be changed daily (as recommended by the manufacturer), which considerably reduces the cost related to their use.[3]

This well-done study provides strong evidence to support the use of closed suction in patients with acute lung injury. ■

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References

1. Cereda M, et al. *Intensive Care Med*. 2001;27:648-654.
2. Hess DR, et al. *Respir Care*. 2003;48:869-879.
3. Wong SY, et al. *Respir Care*. 2001;46:1070.
4. Witmer MA, et al. *Respir Care*. 1991;36:844-848.

Bilateral Pleural Effusions: Do Both Sides Need to be Tapped?

ABSTRACT & COMMENTARY

Synopsis: *In this retrospective review of 33 patients with bilateral pleural effusions who had the fluid on both sides tapped, the cause of the effusions was most often cardiac disease and seemed to be the same on both sides in every case.*

Source: Kalomenidis I, et al. *Chest*. 2003;124:167-176.

Kalomenidis and colleagues at St. Thomas Hospital in Nashville reviewed their prospectively accumulated database of all pleural fluid specimens obtained from both inpatients and outpatients under ultrasound guidance since 1997 in their institution. There were 33 patients (2.5%) who had bilateral effusions and had both sides tapped on the same day. After incomplete data and inconclusive clinical diagnoses, were excluded, 27 patients comprised the study population. There was no significant difference in the mean values of any pleural fluid characteristic between right and left sides, and no case in which one side was an exudate and the other side a transudate. In their primarily cardiac hospital, the most common etiologies were post-coronary artery bypass grafting (CABG; 13 patients; 48%) and congestive heart failure (12 patients; 44%). The only other diagnoses were renal failure and malignant pericardial effusion-associated pleural effusions in a patient with lung cancer. Kalomenidis et al concluded that, in patients with bilateral pleural effusions, diagnostic thoracentesis need not be performed on both sides unless there is a specific indication.

COMMENT BY DAVID J. PIERSON, MD

Can we take the results of this study to mean that ICU patients with bilateral effusions only need to have one side tapped? I don't think so, for several reasons. Although this is the only study published so far to focus specifically on bilateral pleural effusions, it dealt with both outpatients and inpatients in an institution that sees mainly patients with cardiac disease. The situation may be different in the general medical-surgical ICU population.

Pleural effusions in ICU patients have been the subject of previous study. Mattison and associates studied 100 consecutive medical ICU patients using both chest x-rays and ultrasound and found pleural fluid in 62 of them.[1] The fluid was bilateral in 34 (55%). Congestive heart failure was the most common etiology. This study was done by a group with a special issue in pleural disease, and special efforts were made to detect effusions, many of which were small.

The differential diagnosis of bilateral pleural effusions is somewhat different from that for fluid collections in only 1 hemithorax. Bilateral effusions are most likely to be due to congestive heart failure, post-CABG (the mechanism for which is unknown), or metastatic malignancy. Less commonly, they can occur in drug-induced pleuritis, rheumatoid disease, systemic lupus erythematosus, and benign asbestos-related pleural inflammation. They can also be seen in pulmonary embolism, pericardial disease, and renal failure. However, the most worrisome possible etiology in a critically ill patient is infection. Although bilateral pleural effusion can occur in tuberculous pleuritis, this is unusual. Parapneumonic effusions are common, however, and of greatest concern is the possibility of bilateral parapneumonic effusions, one of them an empyema. In such an occurrence, if only the noninfected side was sampled by thoracentesis, substantial morbidity or even mortality could result from not initially tapping the other side. This is because a number of outcome measures in patients with parapneumonic pleural empyema are strongly correlated with rapidity with which complete pleural drainage or other definitive surgical procedure is carried out.

Kalomenidis et al recommend bilateral thoracentesis under the following circumstances: coexisting unilateral parenchymal abnormality; pleural effusions of markedly different sizes; parapneumonic effusions; metastatic malignant effusions; or if fluid on non-tapped side persists after successful therapy for the side that was tapped. I concur with these recommendations, and would add 2 more for patients in the ICU:

- When one pleural space has recently been invaded, or might have been invaded, as with penetrating trauma, surgery, attempted line placement, or endoscopy, and the effusion appears or increases within a day or two of that event; and
- When a patient with bilateral effusions from heart failure or other benign condition develops a new episode of clinical sepsis.

Reference

1. Mattison LE, et al. *Chest*. 1997;111:1018-1023.

Are 'Routine' Daily Chest X-Rays Justifiable in ICU Patients?

ABSTRACT & COMMENTARY

Synopsis: *For patients who required > 48 hours of mechanical ventilation, daily routine chest radiographs and films obtained based on clinical indications produced similar outcomes.*

Source: Krivopal M, et al. *Chest*. 2003;123:1607-1614.

TWO DIFFERENT SCHOOLS OF THOUGHT EXIST regarding the need for daily routine chest radiographs (CXRs) in the ICU: 1) they are essential because there is a high prevalence of unsuspected findings; and 2) they are unnecessary because they rarely discover findings that change management decisions. This study was conducted to systematically examine this question by randomizing patients on mechanical ventilation for > 48 hours to routine or nonroutine CXRs, and evaluating findings in regard to their diagnostic, therapeutic, and outcome efficacy. New findings were defined as any process that had not been seen on the prior CXR. Subjects were 94 patients admitted to a medical ICU who were randomized to routine (n = 43) or nonroutine (n = 51) CXRs and were followed to extubation or death. There were no significant differences between groups, with respect to age, medical insurance, major comorbidities, or reason for mechanical ventilation.

In the routine arm, 33.4% of 293 CXRs indicated new findings, as compared to 53.1% of 226 CXRs in the nonroutine arm (P = 0.004). Only 13.3% of the CXRs in the routine arm prompted an intervention, as compared to 50% of those in the nonroutine arm (P = 0.002). The proportion of CXRs with new findings was 1.59 times greater in the nonroutine arm (95% confidence interval [CI], 1.16-2.18). The interventions were further evaluated in terms of whether they were major (eg, diuresis, antibiotic added, thoracentesis, bronchoscopy, chest tube placement) or minor (eg, tube or line adjustments, chest physical therapy). Only 18 (9%) of routine CXRs led to any intervention and only 9 (4.5%) of these resulted in a major intervention. There was no difference in the mean duration of mechanical ventilation (P = 0.2606), ICU stay (P = 0.1936), or total hospital stay (P = 0.2199) between groups. There was also no difference in the final discharge site or mortality between groups.

COMMENT BY LESLIE A. HOFFMAN, RN, PhD

Findings of this study support the concept that patients who are mechanically ventilated for > 48 hours receive no additional benefit from mandated daily routine CXRs in terms of diagnostic or therapeutic efficacy. Further, there were no differences in the duration of mechanical ventilation, ICU or hospital lengths of stay, disposition, or mortality. Prior studies that have addressed this question have reached different conclusions, despite similar results. In one study, unanticipated findings were reported in 3.4% of routine CXRs, prompting a recommendation for daily routine CXRs.[1] However, most of these unanticipated findings related to malpositioning of endotracheal and nasogastric tubes. A second study also reported a 3.4% incidence of unsuspected CXR findings.[2] Again, most unanticipated findings related to malpositioning of endotracheal and nasogastric tubes. However, Silverstein and associates recommended CXRs only when clinically indicated.

In the present study, patients were enrolled after they had been on mechanical ventilation for > 48 hours. This time period was chosen to avoid the initial hours after intubation when CXRs are typically ordered for various clinical reasons. Perhaps the best strategy is a combination of both approaches—routine daily CXRs during the first 48 hours of intubation, followed by CXRs when clinically indicated. As expected, the number of CXRs was greater in the routine group. However, the differences were not as great as might be anticipated (routine group = 6.8 per patient; nonroutine group = 4.4 per patient). Accordingly, it appears that patient condition indicated the need for a CXR on most study days. Those CXRs that were eliminated likely would have been ordered for stable patients at low risk for problems. Krivopal and colleagues were also able to demonstrate high diagnostic efficacy for a strategy that involved nonroutine CXRs. More than 50% of CXRs ordered for a clinical indication demonstrated a new finding, and half of these prompted a new intervention. Of the 293 CXRs in patients in the routine group, 93 (15%) were done when there was a clinical indication for the procedure. With these eliminated, only 9 of 200 CXRs resulted in a major intervention.

Findings of this study provide additional support for the assertion that patients receiving mechanical ventilation for > 48 hours receive no additional benefit from a daily CXR. An added benefit of this strategy is the

decreased cumulative radiation exposure and reduced cost. ■

References

1. Hall JB, et al. *Crit Care Med*. 1991;19:689-693.
2. Silverstein DS, et al. *J Trauma*. 1993;35:643-646.

Special Feature

Avoiding Adverse Events in the ICU

By Leslie A. Hoffman, RN, PhD

Health care workers are expected to practice without error, an ideal that in reality does not occur. In fact, errors occur more frequently that we would prefer.[1-3] Because the likelihood of adverse events tends to increase with the severity of illness and complexity of care, the risk for errors is especially high in critical care settings.[1,3] It has been estimated that nearly all ICU patients suffer at least 1 preventable adverse event during their hospitalization.[3] With publication of the Institute of Medicine Report, *To Err is Human*,[4] which estimated that 44,000-98,000 preventable deaths occur annually in US hospitals, pressures to increase the quality of care have increased. Although these estimates have been challenged, the report highlights a problem that deserves attention. This brief essay summarizes strategies that have been advocated as a means of reducing adverse events.

Models of Error Causation

Problems due to human error can be viewed from the perspective of 2 models of error causation: the person approach and the system approach.[5] Each model has a different explanation for causation and, therefore, a different approach for prevention.

The *person approach* focuses on unsafe acts of individuals. Adverse events are viewed as primarily arising from behaviors such as carelessness, forgetfulness, poor motivation, etc. Corrective measures are directed at changing the behavior of individuals through retraining, disciplinary actions, new or revised procedures, etc.[5] There are several weaknesses of this model. First, it attributes errors to "bad behavior," rather than acknowledging that adverse events can occur even when every attempt is made to do what is correct. Second, it suggests that there is a single "root cause" for the problem. Finally, it does not promote reporting of problems due to its emphasis on personal failure.[2,5]

The *system approach* views humans as fallible and assumes that errors are to be expected, even in the best organizations. In this model, multiple defensive layers are used to minimize the likelihood of error-provoking conditions. The goal is to include sufficient barriers and safeguards to prevent adverse events from occurring. Some of these barriers are engineered, some rely on individuals, and some rely on procedures and administrative controls. A major strength of the system approach is that it encourages a "reporting culture" in which mishaps and near misses are reported so that the system can be fixed at whatever level is necessary—person, team, task, unit, institution.[2,5]

Most health care institutions use the person approach. Conversely, most high reliability organizations, eg, airline pilots, air traffic controllers, nuclear power plants, etc, use the system approach. Notably, these groups have few adverse events. Although the work of these groups seems remote from clinical practice, safety scientists argue that their defining cultural characteristics could be imported into health care organizations with positive benefit.[5]

ICU Physician Staffing

A growing body of evidence supports the assertion that quality of care in the ICU is strongly influenced by whether care is led by intensivists.[6] If so, intensivist-led ICU care has the potential to decrease the number of adverse events in the unit, including those that increase mortality. Pronovost and colleagues[7] reviewed findings of 26 studies conducted in North America, Europe, and Asia examining the association between ICU physician staffing and patient outcomes. ICUs were grouped into 2 categories: high-intensity (all care directed by intensivists or mandatory intensivist consultation) and low-intensity (no intensivist or elective intensivist consultation). High-intensity staffing was associated with lower hospital mortality in 16 of 17 studies (94%) (95% confidence interval [CI], 0.62-0.82) and a lower ICU mortality in 14 of 15 studies (93%) (0.61, 95% CI, 0.50-0.75). High-intensity staffing also reduced hospital stay and ICU length of stay. Study findings were consistent across a variety of populations and hospital settings. If high-intensity staffing can reduce mortality by 30%, as suggested by this review, and if it were fully implemented in all nonrural hospitals in the United States, it has been estimated that more than 160,000 lives per year could be saved.[8]

House Staff

Volpp and Grande[9] identified 8 frequent but easily remediable problems affecting the environment in teaching institutions that predispose to adverse events. These were:

1. **Frequent interruptions for paging.** Frequent paging interrupts patient care, causes distractions, and is a likely source of errors. While emergencies require an immediate response, many pages are for routine matters. With alphanumeric pagers, messages could be designated as emergent, urgent, or routine. Routine communications about patients could be restricted to specific times (first 10 minutes of the hour) or sent via e-mail.[9]
2. **Handwritten orders and elusive records.** Medication errors constitute a substantial proportion of adverse events in hospitals. Illegible writing is a common culprit. Computerized medication ordering systems can prevent medication errors by scanning for potential drug interactions, a history of allergies or other contraindications, and cross-checking orders with laboratory values. More sophisticated systems can provide decision-making assistance, eg, dose alterations for age or renal disease. While some believe such systems undermine training, it can also be argued that they can have a positive training effect.[9] The presence of a pharmacist on ICU rounds as a full member of the patient care team has also been shown to be effective in reducing medication errors. In one study, the rate of preventable adverse drug events decreased by 66% from 10.4 per 1000 patient days without pharmacist participation to 3.5 per 1000 patient days with the pharmacist present.[10]
3. **Sign-out procedures.** Vital information regarding a patient caseload that is transferred when another provider takes over responsibility is often conveyed in a remarkably haphazard manner, a factor that can increase errors.[11] Computerized sign-out systems are available that automatically include up-to-date information on drug allergies, current medications, recent tests, relevant history, code status, and other important information. Such systems avoid problems with handwritten notes, which may be incomplete, and improve the continuity of care.[9]
4. **Work schedules.** Recent standards enacted in June 2003 mandate strict limits on the amount of time that medical trainees can work each week.[12] Some have criticized this change. However, it is well established that cognitive function declines with sleep deprivation and fatigue is a common source of errors. Consequently, this mandate may reduce errors and improve, rather than decrease, efficiency.[9]
5. **Charts and emergency equipment.** Looking for charts and equipment, including emergency equipment, wastes time. Hospitals could develop standardized procedures for placement and location.
6. **Academic culture.** Medical training commonly uses the person approach when attempting to identify causes of adverse events, eg, the individual was not "careful enough," "didn't try hard enough," "did not do enough reading." Consequently, house staff may be reluctant to acknowledge even the most serious errors, a behavior that prevents identifying changes that could prevent future problems.[13] System flaws are best identified in an environment in which emphasis is placed on changing the system to prevent problems, rather than attributing blame.[9]
7. **Training in procedures.** The "see one, do one, teach one" approach to training is clearly not the best. Several studies have evaluated outcomes of standardized skills training with positive outcomes in academic and community settings.[14,15] The wider availability of high-fidelity human simulation mannequins offers the potential of learning procedures in a safe environment and sharpening diagnostic and procedural skills in scenarios that test ability to quickly diagnose and treat a wide variety of cardiopulmonary emergencies.
8. **Leadership.** When care is delivered by teams of health care professionals, proficiency is enhanced by good leadership, communication, and coordination. Other industries with similar structures, eg, the aviation industry, provide formal training in team management and mandatory refresher courses. The ability to lead a team effectively can be learned by trial and error, but the time expended detracts from other responsibilities.[9]

ICU Nurse Staffing

A growing body of evidence suggests that adequate ICU nurse staffing is a critical determinant of patient outcomes. Understaffing has been associated with an increased risk for errors, iatrogenic complications, nosocomial infections, and death.[6,16,17] In patients undergoing hepatectomy, having fewer nurses at night was associated with an increased risk for reintubation and additional costs.[16] In 2606 patients undergoing abdominal aortic surgery cared for in ICUs, the likelihood of cardiac and pulmonary complications was increased by low- vs high-intensity nurse staffing.[17] The increased

risk of complications may reflect a difference in the level of monitoring by nurses or an insufficient number of nurses to perform interventions such as pulmonary hygiene. Given the current nursing shortage, these findings provide compelling support for efforts to improve ICU staffing.

How to Implement a System Approach

At Johns Hopkins, the use of a system approach was tested in an intervention designed to improve care of mechanically ventilated patients. In well-controlled randomized trials, several therapies have been shown to improve outcomes in mechanically ventilated patients, including elevating the head of the bed, peptic ulcer disease prophylaxis, deep vein thrombosis prevention and holding sedation so that patients can follow commands once a day. Despite evidence of benefit, Berenholtz and colleagues[3] observed that use of these interventions varied widely in their ICU. To change practice, they devised a "care bundle," which included these 4 interventions. The goal was to reduce the complexity and enhance redundancy by "bundling" the 4 interventions into 1 component of care. They devised a visual tool that consisted of a ventilator with attached signs indicating the 4 measures, conducted an educational program, and developed a "daily goals" checklist to document if the therapies were provided. The checklist was completed on all patients by the ICU team during rounds, signed by the fellow or attending physician, and given to the bedside nurse before moving on to the next patient. The care bundle strategy increased the percentage of patients receiving all 4 interventions from 30% to 96%. All providers reported the checklist was easy to use, and its use has been extended to other ICUs in this health care system. This strategy is notable because it appears to have overcome barriers commonly encountered when attempting to change practice in ways that correspond with evidence-based medicine.

Facilitated incident monitoring (FIM) is a technique designed to detect adverse events that relies on voluntary, anonymous, and nonpunitive reporting of incidents by all ICU staff.[18] Beckmann and colleagues[18] tested the use of this approach in a 12-bed closed ICU. Medical and nursing staff were asked to identify incidents in which they were involved and to report them using an incident report form. Over the 2-month data collection period, 100 FIM reports were submitted. Nurses submitted half of the reports and half were submitted by attending physicians or housestaff. FIM identified more preventable adverse events than medical chart review and provided more useful information about the context in which the incident occurred, aspects that were helpful in identifying how to prevent future problems. FIM has the potential to facilitate system change because it promotes an organizational culture in which all team members work together to identify and eliminate potential causes of adverse events.[1-3]

Summary

The person model of causation has proven not effective in preventing adverse events, and there is little reason to believe that it will become more effective in the future. The system approach has several attractive characteristics. It encourages a culture in which mishaps and near misses are reported so that the system can be fixed. This approach has a long tradition of effectiveness in other high-risk organizations, such as commercial aviation and nuclear power. Preliminary evidence suggests that strategies that incorporate this approach can be successful in critical care settings. Several other strategies hold promise for reducing the number of adverse events, including staffing of ICUs by intensivists, adequate ICU nurse staffing, pharmacist participation in rounds, and changing the teaching environment in ways that reduce the risk of making errors. ■

References

1. Graf J. *Crit Care Med*. 2003;31:1277-1278.
2. Berwick DM. *N Engl J Med*. 2003;348:2570-2572.
3. Berenholtz SM, et al. *Comtemp Crit Care*. 2003;1(1): 1-10.
4. Institute of Medicine. *To Err is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 1999.
5. Reason J. *BMJ*. 2000;320:768-770.
6. Brilli RJ, et al. *Crit Care Med*. 2001;29:2007-2019.
7. Pronovost PJ, et al. *JAMA*. 2002;288:2151-2162.
8. ICU Physician Staffing. The Leapfrog Group. Available at: www.leapfrog.org.
9. Volpp KGM, Grande D. *N Engl J Med*. 2003;348: 851-855.
10. Leape LL, et al. *JAMA*. 1999;282:267-270.
11. Petersen LA, et al. *Ann Intern Med*. 1994;121:866-872.
12. Accreditation Council for Graduate Medical Education (ACGME). ACGME duty hours standards now in effect for all residency programs. Available online at: http://www.acgme.org/Media/news7_1_03.asp.
13. Wu AW, et al. *JAMA*. 1991;265:2089-2094.
14. Sherertz RJ, et al. *Ann Intern Med*. 2000;132:641-648.
15. Warren DK, et al. *Crit Care Med*. 2003;31:1959-1963.
16. Dimick JB, et al. *Am J Crit Care*. 2001;10:376-382.
17. Dang D, et al. *Heart Lung*. 2002;31:219-228.
18. Beckman U, et al. *Crit Care Med*. 2003;31:1006-1011.

CME / CE Questions

9. Which of the following techniques is associated with the least lung volume change during suctioning?

a. Open suction
b. Suction through a swivel adapter
c. Suction through a swivel adapter with pressure support to produce a peak inspiratory
d. Pressure of 40 cm H_2O closed suction
e Closed suction with pressure support to produce a peak inspiratory pressure of 40 cm H_2O

10. The most common causes of bilateral pleural effusion include:

a. congestive heart failure.
b. postcoronary artery bypass grafting.
c. metastatic malignancy.
d. All of the above
e. None of the above

11. When chest x-rays were obtained only for specific clinical indications, as opposed to being done routinely on a daily basis:

a. only half as many chest x-rays were obtained.
b. more than half the time, the findings prompted a major intervention.
c. patients were weaned from ventilatory support an average of 1 day sooner.
d. All of the above
e. None of the above

12. When a system approach is used to prevent adverse events, important steps include:

a. disciplinary actions.
b. retraining programs.
c. writing or revising policies.
d. implementing multiple safeguards.
e. focusing on how the individual acts in the unit.

Answers: 9.(e); 10.(d); 11.(e); 12.(d)

CME / CE Objectives

After reading each issue of *Critical Care Alert*, readers will be able to do the following:

- Identify the particular clinical, legal, or scientific issues related to critical care.
- Describe how those issues affect nurses, health care workers, hospitals, or the health care industry in general.
- Cite solutions to the problems associated with those issues.

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In Future Issues: ICU Delirium Common in Older Patients

CRITICAL CARE Plus

EXPANDING YOUR FOCUS IN INTENSIVE CARE

Early, Aggressive ICU Nutrition Drawing More Advocates

Practice impacts patient outcomes and hospital budgets alike

By Julie Crawshaw, Critical Care Plus Editor

Most large hospitals today have dedicated ICU nutritionists who make nutritional recommendations for every critically ill patient admitted. Though some physicians remain skeptical of studies that support using early, aggressive enteral or parenteral nutritional support to improve patient outcomes, leaders in nutritional research say that those studies which failed to indicate positive effects were improperly conducted.

Gary P. Zaloga, MD, FACN, FACS, FCCM, Medical Director for the Methodist Research Institute at Clarian Health, Indianapolis observes that nutrition has become a highly complex field, one in which most physicians lack background and experience. He says that choosing the right timing, quality and route for nutritional support are essential for its success.

The effectiveness of nutritional agents is disease-specific, Zaloga says, and it's pretty clear that the major nutritional boosters are glutamine and arginine, both of which are used by immune cells and have regulating properties on different mediators.

Best Products Heavy on Amino Acids

Nutritional research for critical care has focused on finding nutrients that reduce inflammation and bolster immune function. Zaloga says that numerous nutrients in four or five products already on the market have been shown to alter regulation of the immune system and decrease infections.

The best nutritional products contain large amounts of amino acids, Zaloga says, chiefly glutamine and arginine, both of which are used by immune cells and have regulating properties on different mediators. Arginine becomes the essential substrate for conversion to nitric oxide. He adds that many cheap products are available that allow feeding a patient for about $3.50 per day, but these products contain only protein and carbohydrates plus some lipids and vitamins, not the large nutrient dosages demonstrated to be effective. "A problem arises when clinicians who are not very knowledgeable about nutrition dismiss the importance of using pharmaceutical dosages of arginine and glutamine can be as high as 30 grams per day, making up one-third of the entire protein intake," Zaloga says. "When you give such large quantities you inarguably begin to see effects."

Is the Route Question Really Dead?

Zaloga observes that the question of intravenous versus enteral feeding should have been settled years ago because the evidence is overwhelmingly in favor of using enteral feeding, But if you look at practices throughout the United States and the rest of the world, it's still "absolutely astonishing" how many physicians continue to use intravenous nutrition, which Zaloga describes as very detrimental to patient recovery.

Nutritional guidelines have always directed using enteral nutrition whenever possible, he adds, but to some physicians that means "harness all known means to use enteral mode," while others interpret much less strictly. "If the guidelines simply stated we should not use intravenous feeding it would be simple," Zaloga points out. "But every

time I'm on a guideline committee the strong language gets washed out, leaving the clinician with too much leeway in making decisions."

Because guidelines go through many reviewing bodies and changes before they are published, they wind up being worded in such a way that no one knows what they mean. "I've had physicians ask me what a specific guideline means," Zaloga says. I knew what it meant because I was present for the discussions, but the finished product wasn't clear."

Timing is Critical

Both Zaloga and Laura Russo, Registered Dietician at Children's Memorial Hospital/Chicago firmly believe that the earlier nutritional support begins, the more successful it will be. Starting a nutrition support regimen as soon as possible is particularly important for children, whose have more limited protein reserves than adults, Russo says. She notes that, although elderly patients tend to be frailer than children, their nutritional reserve capacity may be somewhat higher.

Russo says that keeping nitrogen balance positive is essential to avoid muscle breakdown, adding that the balancing act is to estimate correct amounts of calories and protein to be given. Available nutritional guidelines for children are based on predicted values in healthy children and lack correlation for the critically ill child. "There's a lot of controversy in the literature about how measured and predicted energy expenditures should be compared," she adds. "In the end, using nutrition to help move children out of the ICU almost comes down to having experience with the patient population."

However, Russo points to a study of 2 of 21 critically ill children with SIRS or sepsis in which researchers found that the energy requirements of these children did not increase.[1] Twenty-one stable control children, matched for weight, were also studied. Seven patients required inotropic support and 17 received mechanical ventilation. Fifteen patients with SIRS had evidence of bacterial, fungal, or viral infection and were considered septic. The study's authors speculated that the ill children diverted energy that would normally be used for growth into recovery processes. In contrast, the energy requirement of adult patients with critical illness or those undergoing severe stress is thought to be increased by 30% above normal.

Zaloga and a colleague also studied sepsis effects in older patients[2] by viewing various cytokines as part of the inflammatory response. "We found that basically they respond in pretty much the same way as in young people."

Therapies can Boomerang

Therapies can boomerang, however; unforeseen effects of a therapy that appear beneficial at one point in time can come back to bite patient and physician alike at a later date. "Data show that using anti-arrhythmic drugs actually increases sudden death mortality rates, yet we treated patients with them for fifteen years because no one did a survival study," Zaloga says. "And patients who received chemotherapy for Hodgkin's Disease fifteen years ago are developing second cancers that are probably related to the treatment of the first."

Assessing the risk-benefit is easier in critical care because patients are already near death. "If making changes in nutrition helps provide critically ill patients with another five years of life, it's worth doing even though we don't know what the risks are 15 years down the road," Zaloga says. For the non-critically ill, however, he adds that taking pharmaceutical dosages of amino acids long term may increase the risk of auto-immune diseases in later life because the nutrients augment ability of immune cells to react to antigens. And while Omega-3's are good for reducing inflammation they also diminish wound healing to some degree. "Inhibiting the inflammatory cascade over long periods of time may not be good," Zaloga adds.

Muhammad Shahzad, MD, attending and consulting physician at Kindred Hospital, Northlake, Illinois, is convinced that nutritional support boosts favorable ICU outcomes.

After the first couple of days, Shahzad says, critically ill patients have no protein stores and their body systems, especially skin, begin to break down. Nutritional support, Shahzad says, prevents such breakdowns while providing enough caloric intake as well. "Most of my patients reside in nursing homes," Shahzad says. "If they are nutritionally depleted it can spell disaster." For more information, contact Gary P. Zaloga (317) 962-2000; Laura Russo (773) 880-6930 ext. (2565); Muhammad Shahzad (312) 493-9890. ■

References

1. Turi RA, et al. Energy metabolism of infants and children with systemic inflammatory response syndrome and sepsis. *Ann Surg*. 2001;233(4):581-587.
2. Marik PE, Zaloga GP. The effect of aging on circulating levels of proinflammatory cytokines during septic shock. *J Am Geriatrics Soc*. 2001;49(1):5-9.
3. Zaloga GP. Early enteral nutritional support improves outcome: Hypothesis or fact? *Crit Care Med*. 1999;27:259-261.

Who Gets What in Critical Care?

Task force tackles care rationing initiative to yield ethical guidelines for limiting treatment

Two severely ill patients in the emergency department of your hospital need admission to intensive care, but only one bed is available. Who gets admitted first?

Another critical care patient is severely ill, with several coexisting conditions. A costly new medication is available to treat one problem, but her treatment may be complicated due to the other comorbidities. The new treatment also is in short supply. If she gets the medication, it might be unavailable for other patients who could benefit more. Should the physician take a chance and prescribe the medication, anyway?

These are some of the dilemmas that critical care specialists face nearly every day in the United States—limited resources and overwhelming demand.

The end result, say experts, is that most are now engaging in bedside rationing—deciding on a case-by-case basis which treatments to restrict or offer based on their assessment of the potential benefit to the patient vs. the costs to the system and to others.

In a 2002 survey of more than 5,000 members of the Society of Critical Care Medicine (SCCM) two-thirds of the respondents stated they would withhold from one patient a medication, test, or service that is in limited supply in order to give it to a patient who might benefit more.[1]

In addition, more than half of those providers reported routinely withholding medications, tests, or services from patients when they felt that costs outweighed the potential benefit. Yet most also indicated they wanted more guidance on how to make such decisions.

"The survey basically showed that a high percentage of physicians ration and, at the same time, feel badly that they do," says Mitchell Levy, MD, FCCM, FCCP, a critical care specialist at Brown Medical School/Rhode Island Hospital in Providence and chair of Brown University's Values, Ethics and Rationing in Critical Care (VERICC) Task Force. "You have people making decisions at the bedside on resource allocation in a relatively haphazard way, not a measured way. We all struggle to deliver the highest quality of care possible for our patients, and we are successful to varying degrees. But some of the decisions that we make are not made from the broad overview perspective but from a more focused, bedside perspective."

In June, the VERICC Task Force announced a new, 18-month research and education initiative aimed at developing a national consensus on rationing in critical care—to include guidelines to help hospitals and critical care specialists determine how to make treatment decisions when resources are in short supply.

The task force plans to conduct a larger nationwide attitudinal survey of critical care physicians, nurses, hospital administrators and the public to determine what rationing practices take place and the attitude the various groups of people have toward them.

Then, the VERICC group will conduct focus groups, summit meetings and conferences for clinicians, hospital CEOs and administrators that will lead to the development of resource allocation practice guidelines for critical care clinicians.

The task force also wants to develop a comprehensive database and sophisticated software capable of assisting ICU personnel in making resource allocation decisions, no matter where in the country they are located.

"What you'd really like to do [as a physician] is to take into account your patient's perspectives—what they want—and then a more global perspective of what works and what doesn't work and be able to make a more measured decision about the most effective way to apply resources at the bedside," Levy explains. "Unfortunately, there are no guidelines and no clear ways to go about it."

Bringing it Out in the Open

The first step for the task force will be to initiate discussions that encourage physicians to begin talking about their rationing decisions, to educate the public about how and why rationing is necessary, and to foster public dialogue about the moral and ethical values that need to be addressed, says Dan W. Brock, PhD, senior scientist in the Department of Clinical Bioethics at the National Institutes of Health in Bethesda, MD, and a member of the VERICC Task Force.

"There is a denial that it happens on the part of both the health care system and the public," Brock says. "On the part of the public, there is always a concern about getting the care they need, and this sort of belief that rationing does not occur—and if it occurs, it is wrong."

The truth is that rationing of health care services does occur and has always occurred, in some form, and that it is necessary, he adds. "We need to acknowledge that: a) it does happen and has always happened; and b) it is necessary because if we didn't there would be enor-

mous costs. There is an assumption, by many, that all care is beneficial. But few people would say that we should provide all possible care to everyone no matter what the cost."

The initial mission of the task force will be to educate the public about how rationing in critical care occurs, by what criteria resources might be allocated and the processes by which they might be rationed.

Health care providers also must be more willing to discuss rationing in an open way, adds Levy. "We don't want to admit that or talk about these decisions: 'Who should get the bed if I have one left? How much time do I spend with the patient? Who is going to get the more acute nursing care? Which patient should I send down [for a test] if I have to send down one first? Who do I want to insist get the test today and who can wait until tomorrow.' Rationing happens at a very subtle level, and making those decisions is part of medical judgment. But we could provide better help for physicians if we were willing to talk a little more in public."

Models of Ethical Decision Making

The bioethicists on the VERICC panel will help the task force explore the different criteria that might be used to allocate scarce resources, Brock adds.

For example, many may feel that scarce resources should be reserved for those who will most benefit.

"But there are also concerns about justice in medicine—about preserving care for those worst off," he adds.

Patients who have not had adequate access to primary care or care early in a disease process may end up sicker than patients who have had the benefit of better health care overall. Restricting critical care based on the potential for a good outcome may leave out those patients, he notes.

"There are also questions about what weight should be given to patient age," Brock continues. "Should priority be given to younger patients rather that to the old?"

Discussions Guide Rationing Model

The task force is made up of ICU physicians, nurses, bioethicists, hospital CEOs, chairs of hospital departments of medicine, and other policy makers.

Initially, they will sponsor conferences and meetings designed to establish a common taxonomy, Levy says. "We need a unified terminology—when I say the word 'rationing' does it mean what others think it means?" he says. "Then, we need to develop some examples of what we mean, some models of rationing."

At that point, they will initiate the national survey of critical care providers and other stakeholders to find out what methods of rationing and resource allocation currently are used.

The final phase will be a large consensus conference that will work on developing guidelines on critical care resource allocation, he notes.

The guidelines will not be a blueprint for how each treatment, medication, or service should be allocated in each setting, but an effort to guide facilities in determining how they will make their decisions.

Hospitals may end up choosing different criteria on which to base their decisions, depending on the values of their community and the patients that they see and treat, Brock notes.

"It may be that there is not widespread consensus on any one issue," he notes.

Systemic Issues

The task force also intends to examine a number of factors related to critical care outcomes, however, and it may be that many of the guidelines will cover general issues not related to individual patient care at the bedside, say both Levy and Brock.

For example, the role of nursing ratios and patient outcomes will be examined, as will allocation of hospital funding for critical care services.

"The third phase of our project will be to actually build a computerized modeling program that would allow us to figure out in a more careful way what is the impact of allocating different resources," says Levy. "If I am trying to decide between hiring new nurses or buying a new X-ray machine vs. getting expensive new drugs, where am I likely to see the most benefit? So, some of the rationing that is going to occur is going to occur up front and not have to trickle down to the bedside level."

More information on the VERICC project can be found on the group's web site at www.vericc.org. And information on rationing in critical care medicine at the national survey of critical care providers can be found on the web site of the Society for Critical Care Medicine at: www.sccm.org. (Editor's note: For more information contact Dan Brock, at Human Values in Medicine, Department of Philosophy and Program in Medicine, Providence, RI 02912, and Mitchell Levy, MD, at Box G-RIH, Brown University, Providence, RI 02912-G). ■

Reference

1. Levit K, et al. Trends in U.S. health care spending, 2001. *Health Affairs*. 2003;22:154-164.