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The Toxic Wake of Rudeness: Why It Matters

In the midst of a good workday, you walk past 2 colleagues conversing in the hallway and are quite sure that you overheard a disparaging remark about you, especially when their conversation halted while you passed by. You didn’t say anything to either, but returned to your patients, feeling a bit piqued. As your shift continues, do you forget about the remark? Or is it still circling in your subconscious, then reappearing in alternative self-defensive comebacks, retaliatory strategies, or even forms of revenge? Was that what you were ruminating about when you nearly overlooked your patient’s dressing change? Did you approach either of those colleagues to confirm or disconfirm your impression? No? Have you actively avoided contact with either of them since that perceived slight? Behold the toxic wake of rudeness— even misperceived.

Rude behavior and utterances are so pervasive today that it is sometimes difficult to find a serene environment for work or leisure devoid of the verbal and visual intrusions that bombard us. The increasing prevalence of rudeness within our work environment poses particular challenges when the substance of our work is supposed to be therapeutic. In an acute care, progressive care, or critical care setting, the aftermath of rudeness can be toxic to us as individual critical care nurses, to our relationships with peers and team members, to our unit and facility. Rudeness can flow into ever-expanding spheres like a toxic waste that contaminates all it reaches. Prior research on management dynamics identified the problem of rudeness within many organizations, including health care. Those findings were underscored more recently with a study revealing that rudeness impairs the diagnostic and procedural performance of neonatal intensive care unit physician-nurse teams, potentially leading to “profound, if not devastating effects on patient care.”

Definitions and Descriptions of Rudeness

The term rude refers to something that is “offensively impolite or ill-mannered,” something “discourteous,” especially when deliberate, lacking in “concern or respect for the rights and feelings of other people.” Rudeness is similarly defined as a “lack of manners or discourtesy.” An expert on this issue defines rudeness as “insensitive or disrespectful behavior . . . that displays a lack of regard for others.”

Rudeness may originate from different sources, be intended or inadvertent, real or imagined, and manifested in multiple ways. Relative to the recipient, rudeness may arise from a direct authority or hierarchical figure, peer, subordinate, or unrelated third-party. Some of the ways in which rudeness is manifested include displaying little interest in others’ opinions, withholding important information, talking down to or interrupting others, disparaging or belittling others, neglecting to say please or thank you, texting or emailing or...
taking calls during encounters, taking others for granted, not listening, or using facial gestures or body language that reflect condescension or disinterest.7

Why Rudeness Matters

Christine Porath, who has studied workplace rudeness and incivility for nearly 20 years, recently summarized research findings related to the aftermath of rudeness: “How we treat one another at work matters. Insensitive interactions have a way of whittling away at people’s health, performance and souls.”7

Rudeness Extracts Personal Costs

As the opening scenario depicts, subjection to rude behavior can launch a cascade of negative effects that ripple wide, deep, and long. Some of the personal costs of rudeness include frustration, anger, worry, interference in processing information, and reduced work performance.1,8

Rudeness Disrupts Cognitive Functioning

In a series of experiments, researchers6 demonstrated that even a single, relatively mild form of rudeness diminished performance on cognitive tasks manifested by a loss of task focus and reduced creativity in problem-solving. Related experiments revealed that the source of an act of rudeness did not alter its negative influence on the recipient’s performance and that just imagining a rude encounter produced the same trio of detrimental effects as actually experiencing one.

When individuals feel disrespected, they may respond by losing interest in what they are doing or by engaging in mental calisthenics that wrestle with the rude encounter. Rather than just getting past the incident, victims may expend considerable effort cogitating retaliatory responses, second-guessing why it occurred, or endlessly ruminating about it. Either actively disengaging from their work or escalating into cognitive overdrive about the incident may divert virtually all of the victim’s available attention away from their customary tasks at hand.9

Cognitive theories of attention,10 explain that individuals possess finite attention span resources for task performance. When engaged in a task, individuals need to allocate their limited attention to that task; if attention strays, task performance can be negatively affected.11 This integrated resource allocation model11 helps to explain how preoccupation with rudeness can interfere with decision-making and procedure performance.

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Another frame of reference for understanding the effects of rudeness on cognition is to consider the burden it places on working memory, the location where information analysis, goal-setting, planning, and management reside.9 Although Porath’s work to date has not clarified how rudeness affects various types of memory, she observed that some type of disruption to working memory occurs:

It is likely that after experiencing rude behavior, people engage in thought processes to try to make sense of the event. Whether they are considering responses, trying to “explain away” the rude behavior, or just ruminating about it, it is clear that these processes take cognitive resources from a task at hand.6(p1193)

In so doing, rudeness robs at least some portion of our working memory that we need to think clearly and critically in assessing and providing patient care.

Rudeness Impairs Creativity

Rude behavior is thought to impair creativity in a comparable fashion. Creativity requires that we simultaneously concentrate on and juggle different ideas, considering numerous possibilities before determining how they might be meaningfully integrated. This process demands substantial mental agility with retrieval and comparison of stored information from long-term memory to information recently stored in working memory. Any interference in these manipulations can stifle the process. Rudeness throws a wrench into this process by robbing cognitive resources: focus is redirected from the task at hand to the rudeness encountered, thereby reducing attention and overloading working memory, resulting in reduced creativity.9

Unfortunately, the ill effects of rude behavior are not confined to the individual recipient, but flow freely to the surrounding work environment, thereby incurring organizational costs.

Rudeness Extracts Heavy and Tangible Organizational Tolls

The field of organizational behavior has long recognized that rude workplace behaviors can precipitate a torrent of detrimental effects by employees, including retaliation,12-17 counterproductive behaviors,18 and withdrawal of support for leaders.19
In a 2013 contribution to *Harvard Business Review*, Porath summarized findings from a poll of 800 managers and staff in 17 different industries (including health care), who identified the following as some of the ways in which they reacted to rudeness directed at them:

- 80% lost work time due to worrying about the incident.
- 78% felt diminished commitment to the organization.
- 66% admitted their work performance had declined.
- 63% lost work time attributable to avoiding the perpetrator.
- 48% intentionally reduced their work effort.
- 47% intentionally reduced their work time.
- 38% intentionally reduced their work quality.
- 25% took their frustration out on customers.
- 12% left their job as a result of the rude interaction.

Whether they recognize or verbally admit doing so, many staff who experience or perceive rude treatment at work find avenues to punish the instigator and organization.

**Rudeness Diminishes Helpfulness**

When people are treated in a rude manner, their inclinations to interact with and help others lessen. As an example, in one test condition where no rudeness was exhibited, 90% of participants attempted to help retrieve something intentionally dropped by the experimenter. After that researcher verbally insulted the participants’ peer group (but not them), only 35% offered that assistance. Even one-time incidents of rudeness curtail helpfulness. It does not matter whether the rudeness is perpetrated by an authority figure or by a stranger, its detrimental effects on helpfulness remain.

**Rudeness Tarnishes Innocent Bystanders**

When reduced helpfulness between coworkers combines with some employees actively avoiding contact with others, the social bonds that might normally afford cooperation, collaboration, and the unifying influence of team spirit may become increasingly difficult to achieve. These conditions may further deteriorate via the spillover effect of rudeness, where its negative effects do not require direct, first-hand experience as the target of a rude encounter, but can be reproduced in innocent bystanders who merely witness rudeness directed at someone else. As a result, just observing disrespectful interactions between coworkers can precipitate work environments where one or only a few “bad apples” can spoil the entire work barrel.

**Rudeness Diminishes Diagnostic and Procedural Performance of Critical Care Providers**

With this background, it is disheartening but not surprising to learn that in a randomized control trial of 24 neonatal intensive care unit teams from 4 Israeli hospitals, rudeness was found to be associated with significantly impaired diagnostic and procedural performance in a simulation exercise on a preterm infant deteriorating with necrotising enterocolitis. After participants were informed that a foreign expert on team reflexivity would observe them, they were randomly assigned to 2 groups. The experimental group heard the expert make mildly rude comments about medical care in Israel before the simulation began and more pointed disparaging comments regarding poor performance of some staff after the simulation started. The control group heard only neutral comments from the expert. Three independent judges, blinded to the groups, used structured questionnaires to assess team performance, information sharing, and help-seeking based on observations of the videotaped simulations.

The primary results from this study were that teams exposed to rudeness had significantly lower diagnostic and procedural performance scores compared to the control teams (2.6 vs 3.2 [P = .005] and 2.8 vs 3.3 [P = .008]). Rudeness alone explained nearly 12% of the variance in both types of performance, 52% of the variance in diagnostic performance, and 43% in procedural performance. Diminished diagnostic performance was mediated by reduced information sharing among those subjected to rudeness, whereas diminished procedure performance was mediated by reduced help-seeking. The authors expressed 2 additional concerns: that the drop in performance observed in some participants who experienced rudeness represented potentially harmful levels of patient care and that the collaborative processes of information sharing and help-seeking that might have helped to compensate for performance deficiencies were also maligned by rudeness. Even for a simulation exercise, the judges witnessed diagnostic and procedural deficiencies attributable to rudeness that could precipitate patient harm.
Closing

So does rude behavior matter to individual critical care nurses and our interactions with coworkers, units, and patients? The evidence that rudeness matters may be obvious from your own experience and is accumulating in the literature, awaiting our recognition and definitive response. Thoughtful recommendations for how to respond are available, though the first step is always recognizing and getting our colleagues to pay attention to its influence. We sometimes need reminding about the value of interacting with one another in a courteous manner. Why? A simple “please” recognizes that we are requesting someone else to respond to our wants or needs, regardless of whether it is their job to do so. Not bothering to include “please” disregards that dynamic and converts a request into something that more closely resembles a demand. Yes, it is a small thing, but it matters—to all of us, our colleagues, teams, unit, and, most of all, our patients. CCN

JoAnn Grif Alspach, RN, MSN, EdD
Editor

References
Use of Ventilator Bundle and Staff Education to Decrease Ventilator-Associated Pneumonia in Intensive Care Patients

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BACKGROUND Ventilator-associated pneumonia (VAP), one of the most common hospital-acquired infections, has a high mortality rate.

OBJECTIVES To evaluate the incidence of VAP in a multidisciplinary intensive care unit and to examine the effects of the implementation of ventilator bundles and staff education on its incidence.

METHODS A 24-month-long before/after study was conducted, divided into baseline, intervention, and postintervention periods. VAP incidence and rate, the microbiological profile, duration of mechanical ventilation, and length of stay in the intensive care unit were recorded and compared between the periods.

RESULTS Of 1097 patients evaluated, 362 met the inclusion criteria. The baseline VAP rate was 21.6 per 1000 ventilator days. During the postintervention period, it decreased to 11.6 per 1000 ventilator days (P = .01). Length of stay in the intensive care unit decreased from 36 to 27 days (P = .04), and duration of mechanical ventilation decreased from 26 to 21 days (P = .06).

Conclusions VAP incidence was high in a general intensive care unit in a Greek hospital. However, implementation of a ventilator bundle and staff education has decreased both VAP incidence and length of stay in the unit. (Critical Care Nurse. 2016;36[5]:e1-e7)

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Educating Health Care Providers in Treatment of Patients With Ebola Virus Disease

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Nurses manage patients with common infectious diseases by following institutional guidelines based on expert advice, evidence in the literature, and a wealth of experience. Today nurses are challenged to provide care to patients with multi-drug-resistant organisms and virulent infectious diseases such as Ebola virus disease. Management of some patients with virulent infectious diseases occurs in the context of minimal experience with the pathogen, course of infection, diagnostics, nursing care, and treatment. Limited evidence exists in the US or international literature about direct nursing care of patients with virulent infectious diseases in the community, clinic, or hospital. Workplaces may have insufficient supplies, equipment, and knowledge of the management of patients with these diseases. At the National Institutes of Health Clinical Center in Bethesda, Maryland, nursing education strategies for enhanced experiential learning are used to prepare staff to care for patients with virulent infectious diseases, especially Ebola virus disease. (Critical Care Nurse. 2016;36[5]:e8-e13)

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The ABCDs of Managing Morbidly Obese Patients in Intensive Care Units

Luis A. Berrios, DNP, MHA, ANP-BC, CCRN

More than one-third of the US adult population and 17% of the youth are now obese, and obesity is associated with more than $147 billion a year in health care costs. Critical care nurses should understand the physiological differences and practice guidelines for patients with a body mass index greater than 30. The ABCD approach encompasses key clinical concepts in the management of critically ill obese and morbidly obese patients, including management of airways and breathing, minimizing nurses’ back and other injuries, increasing awareness of bias, circulation problems, risks of decubitus ulcers and other skin breakdown, differences in drug calculations and metabolism, limitations in diagnostic equipment and imaging, diet and nutritional recommendations, and concerns with durable medical equipment. (Critical Care Nurse. 2016;36[5]:17-26)

As noted in various studies, obesity is a major public health concern that places a major strain on the entire health care system. More than one-third of the US adult population and 17% of the youth are now obese, and obesity is associated with more than $147 billion a year in health care costs. Obesity is defined as a body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) greater than 30; extreme or morbid obesity is a BMI of 40 or greater. Obese patients, especially morbidly obese patients, have higher rates of resource utilization, intensive care unit (ICU) admissions, respiratory failure, and tracheostomy than do nonobese patients. Furthermore, obese patients are at higher risk for postoperative death and complications.

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Using the ABCD approach, list the key clinical concepts highlighted in this article for managing morbidly obese patients in intensive care units
2. Identify key physiologic differences in airway, breathing, and circulation in morbidly obese patients
3. Identify important considerations in diagnostic and general medical equipment in the management of morbidly obese patients

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Critical care nurses should understand the physiological differences and practice guidelines for patients with a BMI greater than 30. The following ABCD approach articulates key clinical concepts in the management of critically ill obese and morbidly obese patients, including management of airway and breathing, minimizing nurses’ back and other injuries, increasing awareness of bias, circulation problems, risks for decubitus ulcers and other skin breakdown, differences in drug calculations and metabolism, limitations in diagnostic equipment and imaging, diet and nutritional recommendations, and concerns with durable medical equipment.

A: Airway

Any patient can have an airway that is difficult to intubate, and various studies indicate that morbid obesity itself is not a predictor of a difficult intubation. However, studies on obesity as a risk factor for airway problems indicate that obesity is a statistically significant but weak predictor of difficult intubation. Compared with non-obese patients, obese patients have an increased tongue size, smaller pharyngeal area, redundant pharyngeal tissue, an increased neck circumference, and an increased chest girth. These changes are associated with obstructive sleep apnea, obesity hypoventilation syndrome, and respiratory failure.

Morbidity obese patients tend to have higher rates of respiratory failure and subsequent intubation.

B: Breathing

Changes in breathing related to obesity include increased respiratory rates, increased oxygen consumption and metabolic requirements of excess tissue, increased work of breathing, and decreased tidal volume. Once a definitive airway is secured, and unless contraindicated, nurses should maintain patients in a reverse Trendelenburg position to decrease intrathoracic pressure and reduce atelectasis, ventilation-perfusion mismatch, and hypoxemia.

Ventilator settings should be set on the basis of the patient’s predicted body weight (PBW) or ideal body weight (IBW) and not on the basis of actual or total body weight (TBW) to avoid barotrauma. Formulas for estimating IBW and PBW vary slightly, and the terms are often used interchangeably. The Acute Respiratory

Author

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Distress Syndrome Network (ARDSnet) uses the Devine formula and the term PBW where PBW = IBW (Table 1 shows how to calculate PBW and IBW).

Because of a heavy, noncompliant chest wall, initial tidal volumes should be set to approximately 8 mL/kg of PBW in most morbidly obese patients and to 6 mL/kg of PBW in morbidly obese patients with ARDS or acute lung injury. Additionally, plateau pressures should be closely monitored and maintained at less than 30 cm H₂O. The addition of positive end-expiratory pressure (PEEP) may help improve lung compliance by reversing atelectasis and increasing functional residual capacity. The optimal amount of PEEP will vary and should be set according to the practitioner’s clinical judgment and the patient’s hemodynamic status. For patients with ARDS, the ARDSnet protocol clearly delineates recommendations for PEEP.

Exubating morbidly obese patients can be challenging because they often require prolonged weaning trials (prolonged duration of ventilation). Bridging extubated patients by using noninvasive positive pressure ventilation (NIPPV) such as continuous positive airway pressure and bilevel positive airway pressure can reduce the incidence of reintubation. Patients who experience hypoxemia despite NIPPV should receive supplemental oxygen; the amount of the supplemental gas should be titrated according to the results of pulse oximetry or arterial blood gas analyses. Supplemental oxygen alone is insufficient therapy for obesity hypoventilation syndrome.

Practitioners should also consider treating all morbidly obese patients with NIPPV during the patients’ sleep to address obstructive sleep apnea and obesity hypoventilation syndrome and reduce the risk of respiratory failure. NIPPV may also be used initially in patients with respiratory failure as a method of preoxygenation before intubation or to delay or avoid intubation. However, the patients must be alert and able to maintain a patent airway, and anxiolytics may be required to help in compliance. Practitioners should not delay prompt tracheal intubation if NIPPV is unsuccessful in a morbidly obese

| Table 1 Body mass index (BMI) classifications and weight-based calculations |
|------------------|------------------|
| **BMI classifications** | **BMI** |
| Underweight | < 18.5 |
| Normal weight | 18.5-24.9 |
| Overweight | 25-29.9 |
| Obesity (class 1) | 30-34.9 |
| Obesity (class 2) | 35-39.9 |
| Extreme obesity (class 3)/morbid obesity | ≥ 40 |

**Weight-based calculations (example of 350-lb patient who is 5 ft 2 in tall)**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Example calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI 1. Multiply weight in pounds by 703</td>
<td>350 x 703 = 246 050</td>
</tr>
<tr>
<td>2. Multiply height in inches by height in inches</td>
<td>62 x 62 = 3844</td>
</tr>
<tr>
<td>3. Divide answer in step 1 by answer in step 2</td>
<td>246 050/3844 = 64</td>
</tr>
</tbody>
</table>

Ideal body weight (IBW) or predicted body weight

| Males: 50 kg + 2.3 kg for each inch over 5 feet | 50 kg + (2.3 kg x 2) = 54.6 kg |
| Females: 45.5 kg + 2.3 kg for each inch over 5 feet | 45.5 kg + (2.3 kg x 2) = 50.1 kg |

Lean body weight (by using Duffull-Green formula¹⁷ and total body weight [TBW] in kilograms [lb/2.2])

| Males: [9270 x TBW]/[6680 + (216 x BMI)] | [9270 x (350/2.2)]/6680 + (216 x 64)] = 71.93 kg |
| Females: [9270 x TBW]/[8780 + (244 x BMI)] | [9270 x (350/2.2)]/8780 + (244 x 64)] = 60.45 kg |

Adjusted body weight

| Males and females: IBW + 0.4 x [TBW – IBW] | For a man, 54.6 + 0.4 x [(350/2.2) - 54.6] = 96.4 kg |

*See below for how to calculate BMI by using pounds and inches. BMI can also be calculated by dividing weight in kilograms by height in meters squared.*
patient, especially a patient who has hypoxemic acute respiratory failure due to pneumonia or after extubation.\textsuperscript{22}

**B: Backs**

Regardless of a patient’s BMI, nurses should be using safe patient handling techniques. According to data from the Bureau of Labor Statistics, workers in hospitals have injuries and illnesses at nearly twice the national mean rate. Nearly 50% of the reported injuries and illnesses among nurses in 2011 were musculoskeletal disorders.\textsuperscript{24} The Occupational Safety and Health Administration recommends the establishment of safe patient handling programs in all nursing units.\textsuperscript{24} The organization emphasizes that successful safe patient handling programs should involve a comprehensive assessment of the nature of patients’ and workers’ needs, full support from members of the hospital administration, involvement of employees, policies that encourage the safest patient handling techniques, the right equipment for the right job, adequate maintenance of equipment, education and training, and ongoing evaluation and improvement.\textsuperscript{24}

According to the lifting equation of the National Institute for Occupational Safety and Health, the maximum recommended weight a nurse should lift while providing patient care is generally 35 lb (16 kg).\textsuperscript{25} Assistive devices should be used if individually lifting more than this weight.

Nursing units should establish policies that incorporate safe patient handling programs to address the transfer and repositioning of morbidly obese patients in order to reduce injuries to both nursing staff and patients. Policies should include information on weight limits for each piece of equipment, the minimum number of staff required according to the patient’s weight and equipment used, and specific protocols to address staff or patient injuries.\textsuperscript{24,26}

**B: Bias**

Bias against morbidly obese patients can be detrimental to their health. Patients’ perceptions of being stigmatized by health care providers, specifically nurses, can lead to feelings of shame, marginalization, and anxiety.\textsuperscript{27} Negative attitudes toward the morbidly obese can result in actions or lack of actions that may greatly affect a patient’s health.\textsuperscript{27} Not having standard supplies and equipment, such as hospital gowns, examination tables, or blood pressure cuffs large enough to accommodate morbidly obese patients, can create an uncomfortable environment. Moreover, health care personnel should avoid voicing their opinions about morbidly obese patients to avoid promoting an unprofessional working environment. Becoming aware of one’s personal biases is the first step in making sure these biases do not affect the care provided.\textsuperscript{27} Regardless of clinicians’ opinions or the reasons for the patients’ level of obesity, the priority is to provide the best quality nursing care while ensuring dignity and remaining compassionate and empathetic.

**C: Circulation**

Patients who are morbidly obese have notable changes in the circulatory system, including hyperkinetic circulation, increased blood volume, increased blood viscosity and fibrinogen, and decreased fibrinolysis.\textsuperscript{28} These factors increase the risk for deep vein thromboses and pulmonary emboli. Standard chemoprophylaxis, such as subcutaneous heparin in combination with sequential compression devices, should always be considered unless contraindicated (eg, bleeding or thrombocytopenia). Morbidly obese patients also have a higher incidence of heart failure, ventricular hypertrophy, and dysrhythmias because of the increased blood volume, preload, afterload, and myocardial work associated with morbidity obesity.\textsuperscript{28}

Gaining peripheral intravenous access in a morbidly obese patient can be challenging and often delays necessary phlebotomy for diagnostic tests.\textsuperscript{29} As a result, many morbidly obese patients require a central venous catheter (CVC).\textsuperscript{30} However, even CVC placement can be challenging, because anatomical structures may be difficult to locate and standard-sized catheters may not be long enough for appropriate placement. According to recommendations,\textsuperscript{25,31} practitioners should use ultrasound technology to accurately locate veins and minimize complications. Although the Trendelenburg position is the preferred position for placement of an internal jugular CVC because the position results in higher central venous volume and larger vein caliber and can prevent air embolus, this position could result in an acute deterioration of cardiopulmonary status due to reduced lung volumes, diminished pulmonary reserve, intra-abdominal
pressure, and elevated right ventricular pressures.30 The Trendelenburg position should be used with caution.

According to the Centers for Disease Control and Prevention,32 more than 30,000 central catheter–associated bloodstream infections occur in acute care facilities each year, resulting in serious infections, typically prolonging hospital length of stay and increasing costs and risk of mortality. Patients with morbid obesity may be at higher risk for these infections than are nonobese patients, and the higher risk may be partly due to the immune dysfunction associated with morbid obesity.34 However, the results of a recent study35 did not indicate any difference in the rates of central catheter–associated bloodstream infections between obese and nonobese patients.

Placing femoral CVCs in obese patients may increase the risk for infection. However, use of the femoral site may be unavoidable, depending on contraindications to placement in other sites.31 The Centers for Disease Control and Prevention recommend stringent education of personnel on proper placement and monitoring of CVCs, routine refresher training, and appropriate nurse staffing because elevated patient to nurse ratios and higher rates of “pool nurses” in units can increase the rate of central catheter–associated bloodstream infections.31 Intraosseous cannulation is another vascular access option that can be emergently placed by nurses.34,36 Insertion sites include the sternum and the proximal or distal tibia and humerus, and nurses can infuse fluids up to 125 mL/min. The intraosseous catheter should be removed within 24 hours of insertion or as soon as intravenous or central venous access has been achieved. Contraindications include fractures or trauma at the insertion site, prosthetic joints near the site, site infections, osteoporosis, and inability to identify appropriate insertion landmarks. Potential complications include extravasation of fluids into the soft tissue, bony trauma from insertion, and osteomyelitis.36

**D: Decubitus Ulcers**

Treatment of pressure ulcers is costly, and the development of pressure ulcers can be prevented by using evidence-based nursing procedures.37 Several factors predispose bariatric patients to loss of skin integrity, including decreased blood and oxygen supply due to increased adipose tissue and an increase in perspiration and skin moisture, increasing the risk for bacterial and fungal invasion.38 Nurses should conduct a thorough wound evaluation, especially in high-risk areas such as the sacrum, buttocks, elbows, and heels, and do a risk assessment by using an instrument such as the Braden Scale when an obese patient is admitted to the ICU. Although scores on the Braden Scale may have insufficient predictive validity and poor accuracy in identifying ICU patients at risk for pressure ulcers,39 the scale serves as a structured and standardized approach for assessing risk.

As of October 2008, hospitals no longer receive additional payments when stage 3 or 4 pressure ulcers develop in patients, and failure to prevent pressure ulcers can result in provider liability.37 The key to preventing decubitus ulcers is pressure redistribution, which involves appropriate use of pressure-reducing devices and positioning of patients.37 Determining the proper device for preventing decubitus ulcers involves a thorough assessment of the patient’s risk for ulcers, the ease of use of the device or equipment, accessibility, and costs (specialty beds can be costly to rent).

The frequency of repositioning should be based on the patient’s activity level and risk for skin breakdown. According to recommendations, patients should be turned within a 2-hour interval, because skin erythema and ischemic changes can occur in healthy adults in less than 2 hours on a standard mattress.37 Detecting and improving the quality of skin perfusion are important and include prompt treatment of hypotension, limiting vasoconstrictive agents, improving cardiac output, and revascularization of distal tissues.37

Other approaches to preventing decubitus ulcers include daily inspection, documentation, frequent skin care, and use of proper assistive devices. The primary goal is to keep the skin clean and dry while avoiding excess dryness and scaling; the risks for infection and skin abnormalities in skin folds is higher in morbidly obese patients than in nonobese patients.38 Deep skin folds such as those under pendulous breasts, groin folds, or under a pannus must be closely monitored, dried thoroughly, and kept as open to air as possible. This goal can be achieved by using soft cloths in between skin folds, special drying products such as moisture-wicking fabric with antimicrobial silver, and fungus-inhibiting powders. Bariatric weight mechanical lateral
transfer devices, ceiling lifts, air-assist devices, and friction-reducing devices should be used to prevent skin shearing.\textsuperscript{38}

Also important is correcting malnutrition, because most likely adequate nutrition helps both prevent formation of pressure ulcers and promote healing of early-stage ulcers.\textsuperscript{38} Promoting early mobility is probably the most important prevention strategy.\textsuperscript{40}

\section*{D: Drugs}

Moderate pharmacokinetic and pharmacodynamic variations are associated with obesity, but obese subjects are often excluded from clinical trials. Consequently, appropriate dosing for obese patients is based on data on “normal weight” nonobese patients.\textsuperscript{31} Various weight-based formulas are used to calculate dosages to avoid unsuccessful treatment, toxic effects, and antibiotic resistance.\textsuperscript{42} Examples of the weights used are IBW; lean body weight or weight devoid of almost all adipose tissue; and adjusted body weight, which includes an adjustment factor of 40\% for patients who are more than 20\% of their IBW (Table 1 describes calculations for these formulas).

Differences in proportion of adipose and lean muscle tissue and fluid status can greatly affect pharmacokinetics, absorption, distribution, metabolism, and excretion of drugs.\textsuperscript{42} Obesity can increase total blood volume and cardiac output and cause alterations in plasma protein binding. Hepatic clearance is usually normal or even increased in obese patients, and renal clearance can increase because of increases in kidney weight, renal blood flow, and glomerular filtration rate.\textsuperscript{43} Volume of distribution in obese patients can be dramatically different than that in normal-weight patients, and the extent of change is based on the intrinsic characteristics of a medication, such as molecular size, degree of ionization, extent of lipid solubility, protein binding, and ability to cross biological membranes.\textsuperscript{42}

Additionally, obesity can alter activity through the cytochrome P-450 pathway, affecting drug clearance. Standard creatinine clearance values may also be inaccurate in morbidly obese patients, and depending on whether IBW or TBW is used in calculations, the values may be overestimated or underestimated.\textsuperscript{42} Dosing of renally excreted drugs should be adjusted on the basis of measured, not calculated, creatinine clearance.\textsuperscript{41}

Active involvement of clinical pharmacologists in the dosing of medications is highly recommended. Important actions include using the appropriate weight-based calculations, educating nursing staff, and establishing protocols for medications used in emergent situations (eg, quick reference guides in medication rooms).

\section*{D: Diagnostics}

Radiology departments face increasing challenges in their ability to perform imaging studies with acceptable diagnostic quality in obese patients.\textsuperscript{43} Because of thick layers of adipose tissue, computed tomography, magnetic resonance imaging, ultrasound, radiography, and even nuclear medicine studies often yield distorted images with limited diagnostic value.\textsuperscript{43} These factors can delay or distort data, placing the health care staff in a diagnostic predicament. Adjustments in radiological techniques to acquire better images can also increase exposure to radiation.\textsuperscript{43}

The scanners commonly used for computed tomography and magnetic resonance imaging have gantry aperture diameter (chest and abdominal girth) restrictions and table load limits. Patients must be able to freely move in and out of the machine’s opening during the procedure. In addition, size restrictions exist to prevent structural damage to the equipment and subsequent injury to the patient. However, devices are now available that accommodate patients weighing up to 650 lb (292 kg), but the patient must meet the aperture diameter standards.\textsuperscript{43}

Nurses should become familiar with the girth and weight restrictions of their facilities’ diagnostic equipment. Nurses should also understand hospital protocols for those occasions when patients do not meet criteria for in-house imaging and for alternative imaging locations. Moreover, hospitals should promote collaboration between nursing and radiology staff to ensure safe transfer, positioning, and monitoring of morbidly obese patients.

\section*{D: Diet}

One incorrect assumption is that morbidly obese patients do not need nutritional support while in the ICU. On the contrary, obesity is associated with increased energy expenditure, insulin resistance, protein breakdown, rapid deterioration in muscle mass, and deconditioning.\textsuperscript{44}
Nutritional support should be initiated within 48 hours of admission, with enough calories to prevent metabolic derangements and protein breakdown, unless contraindicated.44

The association between improved mortality and obesity is confounded by malnutrition status, and critically ill obese patients with malnutrition have worse outcomes than do obese patients without malnutrition.45 However, the commonly used markers for malnutrition, prealbumin and albumin, may not accurately reflect malnutrition. Serum levels of prealbumin and albumin decrease promptly with injury or illness regardless of nutrient intake, and this decrease cannot be assumed to reflect nutritional deprivation. These markers also may not reflect malnutrition until extreme starvation occurs. Therefore, nutritional support should be based on evidence of meaningful benefit from treatment rather than on nutritional markers.46

Data on the dietary recommendations of critically ill morbidly obese patients in the ICU is limited. However, the Society of Critical Care Medicine and the American Society for Parenteral and Enteral Nutrition recommend that obese, critically ill patients with a BMI of 30 to 50 receive 11 to 14 kcal/kg per day of enteral feedings based on actual body weight and that those with a BMI greater than 50 receive 22 to 25 kcal/kg per day based on IBW.47 Contraindications include patients with severely unstable hemodynamic status and patients who have not had adequate fluid replacement because such patients may be predisposed to bowel ischemia. A unstable hemodynamic status by itself is not a contraindication if evidence indicates adequate volume replacement and tissue perfusion.48 Other contraindications include bowel obstruction, severe and protracted ileus, major bleeding in the upper part of the gastrointestinal tract, intractable vomiting or diarrhea, gastrointestinal ischemia, and a high-output fistula.

For critically ill patients who have contraindications to enteral nutrition, early parenteral nutrition is not recommended, and evidence suggests that use of the parenteral route may be associated with an increased risk of nosocomial infections.49 No consistent evidence suggests that early parenteral nutrition decreases the number of ventilator-free days, length of stay, or mortality. When to start parenteral nutritional support is unclear, but parenteral feedings are typically not started before 7 days.49,50 Contraindications to parenteral feedings include hyperosmolality, severe hyperglycemia, electrolyte abnormalities, volume overload, and inadequate attempts to feed enteral.

Dieticians should be consulted to calculate appropriate enteral or parenteral intake on the basis of multiple factors, including renal function and hemodynamic status, and to closely monitor nutritional status.

D: Durable Medical Equipment

Morbidly obese acutely ill patients require specialized nursing care, including techniques, levels of staffing required, and the use of specialized equipment.51 Nurses must be aware of potential hazards to patients and themselves by becoming familiar with the weight and size restrictions of commonly used equipment such as beds, bedside commodes, toilets, showers, doorways, hallways, elevators, and emergency transport equipment.52

Nursing staff should receive routine in-service training on equipment commonly used to support morbidly obese patients (eg, bariatric beds and lifts) in order to prevent injuries of patients and nursing staff. Nurses should also be familiar with the protocols for procuring bariatric equipment within a reasonable amount of time after a patient’s admission. This information is especially important when resuscitative equipment is needed. Moreover, nurses should be proactive in establishing protocols, developing safe lifting policies, using proper assistive equipment, insisting on multidisciplinary teamwork and effective communication, and adopting an effective staff education program.53

Conclusion

As the rates of obesity and morbid obesity continue to increase, critical care nurses must understand the factors involved in managing patients with a BMI greater than 30. Failure to understand the ABCDs—airway, breathing, back, bias, circulation, decubitus, drugs, diagnostics, diet, and durable medical equipment (Table 2)—could lead to catastrophic events for either patients or nurses. Health care facilities must also be prepared to care for patients of any weight and size. This preparation includes conducting structural assessments of facilities, ensuring that support equipment is readily available and that nursing staff are trained to use the equipment, and providing adequate education on the clinical differences between obese and nonobese patients in medical and nursing management.
<table>
<thead>
<tr>
<th>ABCDs</th>
<th>Key points</th>
</tr>
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<tbody>
<tr>
<td>Airway</td>
<td>Anatomical changes in oropharynx, neck circumference, and chest girth&lt;br&gt;Increased risk for respiratory failure, obstructive sleep apnea, and obesity hypoventilation syndrome&lt;br&gt;Place patients in the 25° head-up or reverse Trendelenburg position (unless contraindicated)&lt;br&gt;Potentially higher risk for difficult intubations&lt;br&gt;Have backup emergency airway kits readily available</td>
</tr>
<tr>
<td>Breathing</td>
<td>Increased respiratory rates, oxygen consumption, and work of breathing&lt;br&gt;Increased oxygen requirements, hypoventilation when supine, and decreased time to desaturation&lt;br&gt;Place intubated patients in reverse Trendelenburg to maximize ventilation (unless contraindicated)&lt;br&gt;Ventilator tidal volumes generally 6 to 8 mL/kg of predicted body weight&lt;br&gt;Maintain plateau pressures at less than 30 cm H2O to prevent barotrauma&lt;br&gt;Generally prolonged weaning trials&lt;br&gt;Bridge/place patients on noninvasive positive pressure ventilation (eg, bilevel positive airway pressure) after extubation to minimize reintubation&lt;br&gt;Noninvasive positive pressure ventilation during hours of sleep to address obstructive sleep apnea and obesity hypoventilation syndrome</td>
</tr>
<tr>
<td>Backs</td>
<td>Establish safe patient handling programs in all nursing units (Occupational Safety and Health Administration standards)&lt;br&gt;Provide routine education on safe patient handling and implement policies&lt;br&gt;Do not lift more than 35 lb (16 kg) without an assistive device&lt;br&gt;Ensure adequate staffing ratios to handle patients safely</td>
</tr>
<tr>
<td>Bias</td>
<td>Remain objective and recognize personal biases, which may hinder patient care&lt;br&gt;Avoid verbalizing your personal opinions of patients’ obesity</td>
</tr>
<tr>
<td>Circulation</td>
<td>Increased risk for deep venous thrombosis, pulmonary embolism, dysrhythmias, and heart failure&lt;br&gt;May be difficult to obtain peripheral intravenous access as well as central venous access&lt;br&gt;Ultrasound guidance in obtaining central venous access is recommended&lt;br&gt;Develop central venous catheter bundle for morbidly obese patients&lt;br&gt;Patients may be at higher risk of central catheter–associated bloodstream infection, avoid femoral placement of central venous catheter if possible&lt;br&gt;Nurses can emergently place intraosseous catheters and infuse fluids at a maximum rate of 125 mL/h</td>
</tr>
<tr>
<td>Decubitus ulcers</td>
<td>Decreased blood and oxygen supply to skin due to increased adipose tissue&lt;br&gt;Increases in perspiration and skin moisture increase risk for bacterial and fungal invasion&lt;br&gt;Conduct thorough wound evaluation on admission and routinely monitor (unit specific)&lt;br&gt;Reposition patients with minimal mobility or who are immobile at least every 2 hours&lt;br&gt;Monitor skin perfusion, provide appropriate skin care, address malnutrition&lt;br&gt;Keep skin folds dry—use soft cloths, drying products such as moisture-wicking fabric with antimicrobial silver and antifungal powders; keep open to air&lt;br&gt;Promote early mobility</td>
</tr>
<tr>
<td>Drugs</td>
<td>Altered volume of distribution and pharmacokinetics&lt;br&gt;Alterations in metabolism and renal excretion&lt;br&gt;Be mindful of weight-based calculations such as ideal, adjusted, and lean body weight depending on drug&lt;br&gt;Clinical pharmacologists should assist in calculating drug dosages on the basis of the patient’s weight</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Computed tomography, magnetic resonance imaging, radiography, ultrasound, and nuclear medicine images may be distorted and of limited diagnostic value&lt;br&gt;Be familiar with weight, chest girth, and abdominal girth restrictions for imaging equipment and alternatives&lt;br&gt;Promote collaboration between nursing and radiology staff to ensure safe transfer, positioning, and monitoring</td>
</tr>
<tr>
<td>Diet</td>
<td>Increased energy expenditure, insulin resistance, protein breakdown, rapid muscle mass deterioration&lt;br&gt;Consult dietary services and start enteral nutrition within 48 hours of admission (unless contraindicated)&lt;br&gt;For body mass index 30-50: 11-14 kcal/kg per day enteral nutrition according to actual body weight&lt;br&gt;For body mass index &gt;50: 22-25 kcal/kg per day enteral nutrition according to ideal body weight&lt;br&gt;Early parenteral nutrition is not recommended</td>
</tr>
<tr>
<td>Durable medical equipment</td>
<td>Be familiar with weight and size restrictions of beds, emergency transport equipment, commodes, toilets, showers, doorways, and other commonly used equipment&lt;br&gt;Establish in-service training sessions on bariatric equipment and safe handling techniques&lt;br&gt;Understand policies and protocols for acquiring specialized bariatric equipment</td>
</tr>
<tr>
<td>Recommendations</td>
<td>Establish admission bundles for morbidly obese patients, including specialized equipment, alerts to administration and department leaders (eg, pharmacy, physical and occupational therapy, radiology), and clinical management and documentation alerts in electronic medical records</td>
</tr>
</tbody>
</table>
Recommendations for facilities to ensure optimal patient care include designing a special admissions bundle for morbidly obese patients that includes necessary supplies and equipment (and/or a quick guide on how to procure supplies and equipment); educational handouts for staff; alerts to nursing administration, clinical leaders, and diagnostic departments (eg, pharmacy, radiology); a needs assessment for adequate staffing and training on specialized equipment; and clinical management and documentation alerts in the electronic medical records. CCN

Financial Disclosures
None reported.

Letters

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dotmore


References
35. Lee C, Tefera E, Colice G. The effect of obesity on outcomes in mechani-


Esophageal balloons are used in the respiratory monitoring of critical care patients. After the esophageal pressure is measured, the corresponding pleural pressure in the thorax can be projected, enabling lung-thorax compliance to be partitioned into chest-wall compliance and lung compliance. The esophageal balloon allows determination of transpulmonary pressures and a correspondingly individually tailored approach to respiratory care, such as patient-specific titration of positive end-expiratory pressure for patients with extrapulmonary acute respiratory distress syndrome. Esophageal balloon monitoring provides critical information for selecting ventilation strategies to use in patients with acute respiratory distress syndrome. (Critical Care Nurse. 2016;36[5]:27-36)

When esophageal balloons are placed in critically ill patients receiving mechanical ventilation, the balloons are typically placed by nurses. The balloons allow respiratory care staff and physicians to monitor otherwise inaccessible respiratory values. This article describes the use of esophageal balloons and provides an in-depth analysis of the associated respiratory mechanics to elucidate the use of these devices in critical care practice. This analysis includes the placement of these balloons, the “dynamic occlusion” technique that is commonly used to verify the correct positioning of the balloons, and the associated physiology that describes the critical advantage that such balloons provide to patients with extrapulmonary origins of acute respiratory distress syndrome (ARDS).

Rationale for Increased Use of Esophageal Balloons: Pleural Pressure Measurements

Appropriate and correct estimation of patients’ pleural pressures is a subtle and crucial component of patient care that, according to Laurent Brochard,1 “is underused in everyday practice.” Measurement of esophageal pressure ($P_{es}$) is used to estimate transpulmonary pressure ($P_{tp}$),2-4 which is of utmost importance,
as it permits calculation of the distending pressures of the lung, chest wall, and respiratory system. Measurements of esophageal pressure have also been used to calculate work of breathing and the pressure developed by the inspiratory muscles, as well as to guide weaning from mechanical ventilation. A detailed analysis of patient-specific respiratory mechanics is required to avoid mechanical stress, such as overdistention produced by inappropriate ventilating volumes (volutrauma) or positive end-expiratory pressure (PEEP) that is insufficient to optimize alveolar recruitment and avoid cyclic opening and closing of alveoli (atelectrauma). The esophageal balloon allows such analysis to take place in real time.

The clinical use of esophageal pressure requires a fundamental understanding of the clinical implications of intrapulmonary and extrapulmonary impairments. Measurement of esophageal pressure may be used to determine when it is appropriate to exceed the recommended plateau pressures (Pp) of 30 cm H2O as dictated by the ARDS clinical network (ARDSnet). The ARDSnet was established in 1994 in order to determine safe ventilating volumes and pressures for patients with ARDS; the resulting standards have since been applied to patients receiving mechanical ventilation in general. The ARDSnet provides an excellent set of patient-independent guidelines. An improved approach that uses appropriate adjustments for a patient’s pathophysiology, including use of in situ estimates of pleural pressures via the esophageal balloon, has the potential to lead to improved outcomes in specific subsets of patients with ARDS.

Physiological Background

The respiratory system can be partitioned into various components: the airways, alveoli, and chest wall.

These 3-dimensional structures are conjoined by the pleural space. The pressure at the airway opening (Pao) is called the airway pressure. In unintubated persons during quiet breathing, Pao is the mouth pressure and is equal to atmospheric pressure unless pressure is applied to the nose and mouth. The pleural pressure is the pressure in the pleural space; in a healthy upright human, the pleural pressure (Ppl) remains negative throughout the entire resting respiratory cycle (Figure 1). The continuously negative pleural pressure can be attributed to the elastic tendency of the lung to recoil to a smaller volume versus the tendency of the chest wall to expand. These 2 opposing forces generate a negative pressure in the pleural space at rest, thus preventing the lungs from collapsing. The pressure difference across the lung is termed the transpulmonary pressure (PTP); transpulmonary pressure is the pressure required to inflate the lung, also known as the distending pressure: PTP = Pao – Ppl and thus is equal to the airway opening pressure (Pao) minus the pleural pressure (Ppl). During spontaneous inspiration, pleural pressure becomes more negative, resulting in an increase in transpulmonary pressure, increased lung volume, and ventilation. At the end of resting expiration (when all airflow has ceased), the remaining gas volume in the lungs is known as functional residual capacity, and the pressures at the airway opening (Pao) and alveoli (Pp) have equilibrated (are equal). This equilibration is the reason why there is no airflow at the resting expiratory level.

Altering the pressure applied by a mechanical ventilator to the airway opening during inspiration results in changes to the transpulmonary pressure, lung volume, and ventilation. Measurements of pleural and airway opening pressure allow clinicians to calculate transpulmonary pressure, as well as compliance of the lung and of the chest wall. Without measurement or estimates of pleural pressure, only the compliance of the entire respiratory system as a whole can be calculated. Compliance is defined as the change in volume divided by the change in pressure and is a measure of the distensibility of the lung-thorax system. This compliance value is influenced by the compliances of the lung and of the chest wall, which includes the abdomen.

During an end-inspiratory pause, when airflow is zero, the alveolar pressure is equal to the pressure at the airway opening, as pressures equilibrate when flow is zero. The end-inspiratory plateau pressure (Pplat) is a
measurement of the alveolar distending pressure, the pressure applied to the airways and alveoli in communication with the ventilator. The PEEP is the baseline pressure in the lungs and is critical in preventing alveolar collapse upon exhalation; PEEP also helps restore functional residual capacity to normal when compliance is low. Applying PEEP to the lungs will increase the plateau pressure during an end-inspiratory pause. Esophageal balloons are used to estimate the pleural pressure, separate it from the lung-thorax plateau pressure, and recover the transpulmonary plateau pressure to ensure safe ventilation. Esophageal balloons permit the estimation of the true transpulmonary plateau pressure of the lungs to evaluate ventilating volumes and pressures, which may be higher than the levels recommended in the ARDSnet guidelines, and to select PEEP levels for effective recruitment of functional residual capacity and improve oxygenation (which go hand in hand) on a patient by patient basis. Table 1 summarizes the important calculations of respiratory mechanics that will be used throughout, including those values only recoverable from esophageal balloon measurements.

**Figure 1** Measuring intrapleural pressure with an esophageal balloon. Intrapleural pressure is transmitted through the esophagus to the balloon-tipped catheter.

**Table 1** Important calculations related to interpretation of data from esophageal balloons

<table>
<thead>
<tr>
<th>Name</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal volume</td>
<td>$\Delta V = V_T$</td>
</tr>
<tr>
<td>Transpulmonary plateau</td>
<td>$\Delta P_{TP} = \Delta P_{AO} - \Delta P_{pl}$</td>
</tr>
<tr>
<td>pressure</td>
<td></td>
</tr>
<tr>
<td>Respiratory system compliance</td>
<td>$C_{RS} = \frac{\Delta V}{\Delta P_{AO}}$</td>
</tr>
<tr>
<td>Compliance partitioning</td>
<td>$\frac{1}{C_{RS}} = \frac{1}{C_L} + \frac{1}{C_W}$</td>
</tr>
<tr>
<td>Lung compliance</td>
<td>$C_L = \frac{\Delta V}{\Delta P_{AO} - \Delta P_{pl}}$</td>
</tr>
<tr>
<td>Chest wall compliance</td>
<td>$C_W = \frac{\Delta V}{\Delta P_{pl}}$</td>
</tr>
<tr>
<td>Esophageal pressure</td>
<td>$\Delta P_{ES} = \Delta P_{pl}$</td>
</tr>
<tr>
<td>Transpulmonary plateau</td>
<td>$\Delta P_{TP} = \Delta P_{AO} - \Delta P_{ES}$</td>
</tr>
</tbody>
</table>

*a The following nomenclature is used: $\Delta X = X_{in} - X_{exp}$. Here, $X_{in}$ is the value of $X$ at the end of normal inspiration, $X_{exp}$ is the value of $X$ at the end of expiration. Using this nomenclature, $\Delta V = V_{in} - V_{exp} = V_T$, where $V_T$ is the tidal volume.*
Esophageal balloons permit estimation of the true distending pressures of the lungs, allowing clinicians to select optimal PEEP, improve oxygenation, and ensure safe ventilation.

Of note, respiratory system compliance alone does not enable poor lung compliance to be distinguished from poor chest wall compliance; the inability to partition lung and chest wall compliance may lead to inaccuracies when assessing the severity of a patient’s pulmonary impairment and ventilator management strategies. Determination of the chest wall compliance allows the lung compliance to be projected from the net compliance of the respiratory system without interference; edema in the chest wall, abdominal distention, paralytic agents, or simple changes in the patient’s position will not affect the calculation of the lung compliance as a result. The figure of merit is $C_L$, calculated as $\Delta V / (\Delta P_AO - \Delta P_{pl})$. As described in the next section, it is clinically reasonable to substitute the esophageal pressure for the pleural pressure directly, thus recovering the transpulmonary pressure as $\Delta P_{TP} = \Delta P_AO - \Delta P_{pl}$. One may monitor the compliance of the lung to optimize patients’ outcomes and reduce ventilator-associated injury risks directly.

Pleural Pressure Measurement Techniques

Pleural pressure can be directly measured through invasive methods but is accompanied by a high risk of pneumothorax. These methods typically involve puncturing the chest wall and invading the pleural cavity in several locations and should be avoided. Alternatively, the pressure in the lower third of the esophagus closely parallels the pressure in the adjoining pleura, and that pressure can be measured by using esophageal balloon technology. In fact, esophageal pressure may “represent a better measure of the over-all elastic behavior of the lung than any local pleural pressure.” This measurement is accurate when taken in an upright human lung without the weight of the mediastinum compressing the esophagus and generating large regional variances in pleural pressure.

The relationship between esophageal pressure and pleural pressure, and its measurement with an esophageal balloon, was first outlined in 1949 in a thesis by Buytendijk, and further measurements in the following years confirmed the effectiveness of the technique in the early 1950s. Starting in the late 1950s, results of several studies have strongly supported the use of esophageal pressure as a surrogate for pleural pressure. More recent publications have supported the notion that transpulmonary pressure at the end of inspiration (PTPplat), as a direct measure of lung stress, “might be a better indicator of injury than plateau pressure alone.” One may infer the transpulmonary pressure from the open airway pressure at the end of inspiration and the pleural pressure, in which esophageal pressure is used in lieu of pleural pressure. Additionally, as most measurements are performed using differences between various pressures and volumes, the reported offset between esophageal pressure and pleural pressure does not affect the calculation of most relevant respiratory factors. Calculation of the transpulmonary plateau pressure ($P_{TP\ Plat}$) is of utmost importance (Table 1).

Esophageal Balloon Placement Techniques and the Dynamic Occlusion Method

Evaluation of correct placement of the esophageal balloon uses the process described by Baydur et al, the “dynamic occlusion technique.” The dynamic occlusion technique ensures that the changes in esophageal pressure are sufficiently similar to changes in pleural pressure to allow clinically significant calculations of lung compliance, which is assumed in the preceding equations. Appropriate balloon placement is described in the following paragraphs.

Most esophageal balloons are now available as a single system, typically comprising a thin polyethylene catheter with several holes, possibly in a spiral pattern, on the distal end. This catheter is placed inside the “balloon,” which serves 2 purposes: first, prevention of occlusion of the catheter holes, and second, maintenance of a thin column of air to measure pressure in the surrounding area. Ventilators, such as the Carefusion Avea (BD Worldwide) and Hamilton Galileo (Hamilton Medical), provide integrated esophageal pressure measurements. It is also possible to use available pressure transducers to make these measurements.

For a nasal balloon, the deflated balloon (and catheter) is typically inserted through the nares into the posterior part of the pharynx; if the patient is conscious, he or she is instructed to swallow. The balloon is then passed through the esophagus and into the stomach and is inflated with 2.0 mL of air. Then 1.5 mL of air is withdrawn, to leave...
0.5 mL of air in the balloon. The balloon is then attached to the ventilator or other transduction device.\textsuperscript{13} If the balloon is properly placed in the stomach, a positive pressure deflection will be observed during inspiration. The balloon is then slowly withdrawn into the esophagus, where inspiration will induce a negative pressure deflection. From the point of initial negative deflection, the balloon is withdrawn another full length of the balloon, which is typically 10 cm, to ensure that the entirety of the balloon is within the esophagus. Cardiac oscillations should then appear on the esophageal pressure (P$_{ES}$) waveform. The tip of the catheter is typically within 40 cm (SD, 5 cm) from the nares.

After insertion of the balloon, the dynamic occlusion test\textsuperscript{17} is performed in patients who are spontaneously breathing: at the end of expiration, the airway is occluded, and the ratio of the esophageal pressure (P$_{ES}$) to the airway opening pressure (P$_{AO}$) is measured during several (3-5) inspiratory attempts against the closed airway. The 2 pressure differences should be equal ($\Delta$P$_{pl} = \Delta$P$_{ES}$); by measuring this ratio, the validity of the measurement can be determined and appropriate balloon placement can be confirmed (Figure 2).

The dynamic occlusion test is used to ensure the linearity of the relationship between pleural pressure and esophageal pressure. Thus one can treat the changes in these pressures as clinically equivalent, as outlined in the physiological background section. Occluding the airway prevents airflow, and the lung-thorax system will equilibrate. If the patient is not spontaneously breathing, an alternative method as described by Lanteri et al\textsuperscript{18} can be used, in which correct placement of the esophageal balloon can be verified via observation of cardiac oscillations of the pressure waveform.

**Treatments That Use Esophageal Balloon Measurement**

The use of esophageal balloon measurements to manage several pulmonary disease states and guide the determination of the corresponding ventilator parameters is a suitable demonstration of the effectiveness of partitioning the lung-thorax compliance. Obesity, ascites, ARDS, and other disease states can lead to increased pleural pressure and require a corresponding increase in PEEP.\textsuperscript{19} It is possible that esophageal pressure can be elevated independently of intrapulmonary and extrapulmonary ARDS; for example, obesity and ascites can cause increased esophageal pressure. Under these conditions, the pleural pressure, and correspondingly the esophageal pressure, is increased because of the increased body mass index in obesity or the increased intra-abdominal pressure in ascites.\textsuperscript{20,21} Esophageal balloon monitoring of pleural pressure analogues has many uses besides ARDS treatment, although the latter is the main focus of this article.

One of the primary clinical uses of esophageal balloons is in patients with ARDS.Gattinoni et al\textsuperscript{22} studied patients using both computed tomography and esophageal balloon measurements to identify differences in respiratory system mechanics due to different causes of ARDS. They reported that ARDS patients could be partitioned into 2 groups: 1 with direct pulmonary causes and 1 with extrapulmonary causes.\textsuperscript{22} Esophageal pressure measurement to estimate pleural pressure may be of greatest benefit in monitoring patients with extrapulmonary ARDS.

Discrimination between causes of ARDS is a critical measure; the net respiratory system compliance can be influenced by the compliance of the lung (a “pulmonary” cause) or by an “extrapulmonary” cause; either type will reduce overall respiratory system compliance. Patients with a direct pulmonary source of ARDS, such as aspiration or pneumonia, had low lung compliance but relatively normal chest wall compliance. Gattinoni et al\textsuperscript{22} attributed these findings to alveolar filling and consolidation, which is not very responsive to increases in PEEP. The low lung compliance in these patients suggests that an increase in
PEEP will not increase alveolar recruitment. Extrapulmonary ARDS often manifests as atelectasis, associated with a stiff chest wall or an intra-abdominal process; therefore, the potential for alveolar recruitment is greater than in a primary pulmonary abnormality (Figure 3).

Patients with an extrapulmonary source of ARDS (eg, sepsis, pancreatitis, peritonitis) have relatively normal lung compliance, albeit with a stiff chest wall/abdomen and increased pleural pressure. The underlying lung in these patients is affected primarily by compressive atelectasis rather than alveolar consolidation and has a significant potential for alveolar recruitment with PEEP.10 In addition, patients with ascites, pleural effusion, and possibly obesity also have elevated airway pressures and a greater tendency to externally compress the lung, causing hypoxemia. This category of patients with elevated airway pressure and hypoxemia has the greatest potential to benefit from determination of transpulmonary pressure for adjustment of tidal volume and PEEP.11,19,21 An increase in PEEP above ARDSnet guidelines can still be safe for the patient and effective to counter the compressive pressure caused by these types of abnormalities.

As an extension of the ARDSnet recommendation to keep the airway opening plateau pressure at less than 30 cm H2O, it is common to maintain the transpulmonary plateau pressure at less than 25 cm H2O.23 Transpulmonary plateau pressures approaching 30 cm H2O result in overdistension of remaining normal alveoli, which are still found to exist in nondependent portions of the lung in patients with ARDS.24 Overdistension can damage the alveolar wall as well as their adjacent capillaries; this situation has been called “volutrauma” contributing to ventilator-induced lung injury (VILI).12 However, in patients with extrapulmonary sources of ARDS (ascites, pleural effusion, and possibly obesity), it is quite likely that airway opening plateau pressures greater than 30 cm H2O do not induce VILI because these conditions make pleural pressure positive rather than negative.24 One may better evaluate the cause of increased airway pressure by measuring the transpulmonary plateau pressure.

Measurement of airway opening pressure and esophageal pressure during an expiratory pause allow the determination of the end-expiratory transpulmonary pressure: $P_{\text{TP expire}} = P_{\text{expire}} - P_{\text{ES expire}}$. This end-expiratory transpulmonary pressure is also commonly called $P_{\text{TP PEEP}}$. If pleural (esophageal) pressure is higher than the pressure inside the alveoli, the alveoli will collapse. A negative $P_{\text{TP PEEP}}$ indicates that pleural pressure is greater than alveolar pressure and that PEEP is insufficient to prevent alveolar collapse. Increasing the PEEP to be at least equal to the esophageal pressure during expiration has the potential to prevent collapse and recruit alveoli. It is common to maintain a PEEP level that generates a $P_{\text{TP PEEP}}$ of 0 to 2 cm H2O to optimize alveolar recruitment.25 Part of the mechanism of VILI is the repeated cyclic closing and reopening of alveoli; using a PEEP level that is adequate to prevent this form of shear injury may also decrease VILI.

One significant limitation of esophageal balloons and a source of inaccuracy is the influence of the weight of the heart and mediastinum on esophageal pressures.13,14 Supine positioning places the heart superior to the balloon and falsely elevates the measured pressure. Talmor et al25 subtracted 5 cm H2O from esophageal pressure values to compensate for this effect, agreement has not yet been reached on an optimal method of correcting $P_{\text{ES}}$.14 Reverse Trendelenburg positioning reduces the magnitude of this effect and is generally recommended for measurement.13,14

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**Figure 3** Pathophysiology related to extrapulmonary vs pulmonary acute respiratory distress syndrome (ARDS) and positive end-expiratory pressure (PEEP) levels.
A 5-foot 10-inch (1 m 78), 380-pound (171 kg) man was transferred to a regional medical center from an outlying hospital with ARDS associated with pancreatitis and sepsis. He was stabilized on ARDSnet ventilator settings with a tidal volume of 5 mL/kg ideal body weight, 90% oxygen, and PEEP of 14 cm H$_2$O. Despite these settings, his oxygenation remained marginal and his end-inspiratory plateau pressure exceeded 30 cm H$_2$O (range, 32-35 cm H$_2$O). The patient was frequently asynchronous with the ventilator, which precluded further reductions in tidal volume. The patient’s abdomen was very firm on palpation; the decision was made to institute esophageal pressure monitoring. After sedating the patient further, the nurse and respiratory therapist achieved satisfactory placement of the esophageal balloon. The esophageal and airway opening pressures were measured; Figure 4 shows esophageal and airway opening pressures during an end-expiratory pause, as well as the effect of both those pressures on transpulmonary pressure. The same measurements (esophageal pressure and airway opening pressure) were made during an end-inspiratory pause (Figure 5). Table 2 outlines the mathematical calculation of transpulmonary pressure from those measurements.

These values were interpreted as follows: the $P_{TP} = -4$ cm H$_2$O (without adjusting the $P_{ES}$ for the weight of the mediastinum) indicates that the set PEEP of 14 cm H$_2$O is less than the esophageal pressure of 18 cm H$_2$O, resulting in alveolar collapse at end-exhalation as well as impaired oxygenation. The set PEEP was increased to 18 cm H$_2$O to improve oxygenation; this allowed the inspired oxygen concentration to be reduced to 50%. The improvement in lung recruitment also resulted in an increase in lung compliance. Measurements were repeated after the PEEP was increased, with results shown in Table 3.

Although the increase in PEEP increased both the alveolar and esophageal end-inspiratory plateau pressures, the $P_{TP Plat}$ was 11 cm H$_2$O (less than the guideline value of 25 cm H$_2$O). The medical team thought that allowing an increase in tidal volume to 8 mL/kg ideal body weight in order to eliminate patient-ventilator

![Figure 4 Measurements of airway opening pressure ($P_{A0}$), esophageal pressure ($P_{ES}$), and transpulmonary pressure ($P_{TP}$) during end-expiratory pause. During expiration, the airway pressure is equal to the set positive end-expiratory pressure (PEEP) of 14 cm H$_2$O. At the same time, the esophageal pressure is 18 cm H$_2$O, 4 cm H$_2$O higher than the set PEEP, resulting in a $P_{TP PEEP}$ of -4 cm H$_2$O.](image)

![Figure 5 Measurements of airway opening pressure ($P_{A0}$), esophageal pressure ($P_{ES}$), and transpulmonary pressure ($P_{TP}$) during end-inspiratory pause. During inspiration, peak airway pressure is followed by plateau pressure measurement (period of zero flow). During the plateau period, the airway pressure is 35 cm H$_2$O, esophageal pressure is 25 cm H$_2$O, and the difference between these values, transpulmonary pressure, is 10 cm H$_2$O. Cardiac oscillations are noted in the esophageal and transpulmonary pressure graphs.](image)
Measurement of esophageal pressure with esophageal balloons allows projection of pleural pressure followed by partitioning of the compliance of the lung-thorax system into its individual components. The pulmonary and extrapulmonary causes of ARDS result in elevated airway pressure, alveolar collapse, and hypoxemia, although the mechanisms of the diseases differ. Use of esophageal pressure measurements helps to determine adequate PEEP levels to recruit alveoli and to evaluate for true overdistention of the lungs. When esophageal pressure measurements are used, it is reasonable to exceed the PEEP and end-inspiratory airway opening plateau pressure recommended in the ARDSnet guidelines. “The time is now right to apply the knowledge obtained with esophageal pressure to improve the management of critically ill and ventilator-dependent patients.”26

Financial Disclosures
None reported.

Table 2 Case study: initial set of esophageal balloon catheter values

<table>
<thead>
<tr>
<th>Timing</th>
<th>Alveolar</th>
<th>Esophageal</th>
<th>Transpulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-inspiratory pause</td>
<td>35</td>
<td>25</td>
<td>35 – 25 = 10 (PTP plat)</td>
</tr>
<tr>
<td>End-expiratory pause</td>
<td>14</td>
<td>18</td>
<td>14 – 18 = -4 (PTP PEEP)</td>
</tr>
</tbody>
</table>

Table 3 Case study: esophageal balloon values after positive end-expiratory pressure (PEEP) was increased to 18 cm H2O and oxygen was reduced to 50%

<table>
<thead>
<tr>
<th>Timing</th>
<th>Alveolar</th>
<th>Esophageal</th>
<th>Transpulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-inspiratory pause</td>
<td>39</td>
<td>28</td>
<td>39 – 28 = 11 (PTP plat)</td>
</tr>
<tr>
<td>End-expiratory pause</td>
<td>18</td>
<td>18</td>
<td>18 – 18 = 0 (PTP PEEP)</td>
</tr>
</tbody>
</table>

Table 4 Case study: esophageal balloon values after increasing the tidal volume to 8 mL/kg (from 250 mL to 400 mL)

<table>
<thead>
<tr>
<th>Timing</th>
<th>Alveolar</th>
<th>Esophageal</th>
<th>Transpulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-inspiratory pause</td>
<td>52</td>
<td>34</td>
<td>52 – 34 = 18 (PTP plat)</td>
</tr>
<tr>
<td>End-expiratory pause</td>
<td>18</td>
<td>18</td>
<td>18 – 18 = 0 (PTP PEEP)</td>
</tr>
</tbody>
</table>

The results are shown in Table 4; the new PTP plat was 18 cm H2O, less than the guideline value of 25 cm H2O. The patient was treated for sepsis and pancreatitis and within a week satisfactorily completed a spontaneous breathing trial followed by extubation.

asynchrony was appropriate. Tidal volume was incrementally increased to 8 mL/kg and the breath stacking was eliminated. After increasing the tidal volume to 8 mL/kg ideal body weight (from 250 mL to 400 mL), esophageal pressure measurements were repeated.

Conclusion
Measurement of esophageal pressure with esophageal balloons allows projection of pleural pressure followed by partitioning of the compliance of the lung-thorax system into its individual components. The pulmonary and extrapulmonary causes of ARDS result in elevated airway pressure, alveolar collapse, and hypoxemia, although the mechanisms of the diseases differ. Use of esophageal pressure measurements helps to determine adequate PEEP levels to recruit alveoli and to evaluate for true overdistention of the lungs. When esophageal pressure measurements are used, it is reasonable to exceed the PEEP and end-inspiratory airway opening plateau pressure recommended in the ARDSnet guidelines. “The time is now right to apply the knowledge obtained with esophageal pressure to improve the management of critically ill and ventilator-dependent patients.”26

Financial Disclosures
None reported.

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References

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Esophageal balloons are used in the respiratory monitoring of critical care patients. After the esophageal pressure is measured, the corresponding pleural pressure in the thorax can be projected, enabling lung-thorax compliance to be partitioned into chest-wall compliance and lung compliance. The esophageal balloon allows determination of transpulmonary pressures and an individually tailored approach to respiratory care, such as patient-specific titration of positive end-expiratory pressure (PEEP) for patients with extrapulmonary acute respiratory distress syndrome (ARDS). Esophageal balloon monitoring provides critical information for selecting ventilation strategies to use in patients with ARDS.

- Measurements of esophageal pressure have been used to calculate work of breathing and the pressure developed by the inspiratory muscles, as well as to guide weaning from mechanical ventilation.
- Altering the pressure applied by a mechanical ventilator to the airway opening during inspiration results in changes to the transpulmonary pressure, lung volume, and ventilation.
- The PEEP is the baseline pressure in the lungs and is critical in preventing alveolar collapse upon exhalation; PEEP also helps restore functional residual capacity to normal when compliance is low.
- Pleural pressure can be directly measured through invasive methods but is accompanied by a high risk of pneumothorax.
- The dynamic occlusion technique ensures that the changes in esophageal pressure are sufficiently similar to changes in pleural pressure to allow clinically significant calculations of lung compliance.
- One of the primary clinical uses of esophageal balloons is in patients with ARDS.
- Extrapulmonary ARDS often manifests as atelectasis, associated with a stiff chest wall or an intra-abdominal process; therefore, the potential for alveolar recruitment is greater than in a primary pulmonary abnormality (see Figure).

- Patients with an extrapulmonary source of ARDS (eg, sepsis, pancreatitis, peritonitis) have relatively normal lung compliance, albeit with a stiff chest wall/abdomen and increased pleural pressure. The underlying lung in these patients is affected primarily by compressive atelectasis rather than alveolar consolidation and has a significant potential for alveolar recruitment with PEEP. CCN

HIV infection has progressed from an acute, terminal disease to a chronic illness with cardiovascular disease as the leading cause of death among persons living with HIV. As persons living with HIV infection continue to become older, traditional risk factors for atherosclerosis compounded by the pathophysiological effects of HIV infection and antiretroviral therapy markedly increase the risk for cardiovascular disease. Further, persons living with HIV are also at high risk for cardiomyopathy. Critical care nurses must recognize the risk factors for cardiovascular disease and the pathophysiology and complex treatment options in order to manage care of these patients and facilitate multidisciplinary collaboration. Two case studies are used to highlight the treatment options and nursing considerations associated with cardiovascular disease among persons living with HIV. (Critical Care Nurse. 2016;36[5]:37-47)

Recent advances in the management of HIV infection have increased life expectancy among persons living with HIV. Because persons living with HIV are living longer, they are increasingly affected by health conditions associated with aging, such as cardiovascular disease. Among persons living with HIV, the leading cause of death is cardiovascular disease.1 HIV infection and antiretroviral therapy increase the risk for atherosclerotic heart disease and myocardial infarction by creating a proinflammatory, proatherogenic environment at the onset of HIV infection and throughout the life of the person living with HIV.2 In addition to atherosclerosis, persons living with HIV are also at increased risk for cardiomyopathy and congestive heart failure. Thus, critical care nurses must understand the risk factors, pathophysiology, and unique treatment options related to cardiovascular disease in persons living with HIV in order to provide optimal care. These nurses are responsible for facilitating communication between the interprofessional team members while managing complex drug regimens during a patient’s hospitalization and are essential in providing patient education in preparation for discharge from the hospital.
Epidemiological Perspectives

According to the Centers for Disease Control and Prevention, in the United States, 1.1 million persons are living with HIV infection. The median age of those infected is 45 to 49 years. Two groups disproportionately affected by HIV, males and African Americans, are also at higher risk for hypertension, diabetes, and mortality due to cardiovascular disease. 

Epidemiological evidence indicates that 387,324 African Americans and 658,002 males were living with HIV infection in 2010. HIV infection and antiretroviral therapy increase the risk for cardiovascular disease and accelerate the progression of atherosclerosis. As a consequence of HIV infection, both atherogenesis and endothelial dysfunction are accelerated, increasing the risk for cardiovascular events. Risk factors associated with cardiovascular disease, such as diabetes, dyslipidemia, and hypertension, are more prevalent in persons living with HIV than in the general population. For example, diabetes is diagnosed in 14% of persons living with HIV but in only 8.3% of the general US population. Similarly, dyslipidemia is noticeably more prevalent in persons living with HIV (44.7%) than in noninfected persons (33.5%). Further, hypertension affects 36.5% of persons living with HIV compared with 31.0% of the general population.

After multivariate remodeling for sociodemographic and physiological covariants, a multisite study of more than 27,000 individuals indicated that persons living with HIV are at a 50% higher risk for an acute myocardial infarction than persons who do not have HIV infection. Further, the risk for cardiovascular disease is 2 times higher among persons living with HIV and receiving antiretroviral therapy than among the general public. Persons living with HIV have a higher risk not only for cardiovascular disease but also for complications after acute cardiovascular episodes. Patients living with HIV return to the hospital for heart failure after an acute myocardial infarction at significantly higher rates (3.3%) than do similar patients without HIV infection (1.4%, P = .02).

Atherosclerotic Cardiovascular Disease and HIV Infection

If the HIV disease is well controlled with antiretroviral therapy, persons living with HIV have a life expectancy comparable to that of the general population. As survival has improved, the focus of care has shifted to management of chronic disease in which cardiovascular disease, hypertension, diabetes, and kidney disease are common comorbid conditions requiring care and treatment. In addition to traditional risk factors for cardiovascular disease such as hypertension, tobacco use, dyslipidemia, insulin resistance, genetics, and impaired glucose tolerance, compounding risk factors due to the direct effects of HIV and antiretroviral therapy must be considered.

In all populations, atherogenesis is an inflammation-mediated process. Among persons living with HIV, atherogenesis is accelerated because of a constant proinflammatory state that exists throughout the lifetime of the infected person, even during antiretroviral therapy. Infection with HIV induces inflammatory oxidative stress, stimulates the production of reactive oxygen species, and causes platelet dysfunction. This proinflammatory environment combined with increased levels of reactive oxygen species contributes to plaque formation and accelerates the progression of atherosclerotic disease. Further, reactive oxygen species not only oxidize more low-density lipoprotein but also directly damage the vessel walls, causing endothelial dysfunction.

Exemplar Case Study 1

The following is a case study to explore treatment of a person living with HIV who has cardiovascular disease.
Ronald is a 55-year-old African American man. He is 6 ft (1.8 m) tall, weighs 220 lb (99 kg), and has a body mass index of 29.8. HIV infection was diagnosed in 1990. Since 1994, he has been taking saquinavir with ritonavir, a boosted protease inhibitor regimen. Although saquinavir with ritonavir is not first-line treatment today, Ronald is still on the regimen because it produced virological suppression and he is able to maintain adherence. In 2004, his HIV nurse practitioner modified his antiretroviral therapy by adding tenofovir disoproxil fumarate and emtricitabine, both of which are nonnucleoside reverse transcriptase inhibitors.

In addition to his antiretroviral medications, Ronald currently takes 60 mg pravastatin daily for dyslipidemia. His current lipid profile includes elevated levels of low-density lipoproteins (140 mg/dL), low levels of high-density lipoproteins (35 mg/dL), and elevated levels of total cholesterol (230 mg/dL). (To convert milligrams per deciliter of the 3 types of cholesterol to millimoles per liter, multiply by 0.0259.) He also takes metoprolol succinate 100 mg daily for hypertension. He drinks socially (1-2 drinks a month) and does not use tobacco. He engages in aerobic exercise less than once per week and consumes a diet high in fat and sodium.

Ronald reported that he had been experiencing chest pain at rest. He was referred to an outpatient cardiovascular testing facility to undergo a stress test. During the stress test, ischemia was noted via anterior leads (ST elevation in leads V_1–V_3). The stress test was stopped, and a diagnostic catheterization with possible intervention was ordered. The cardiac catheterization showed that Ronald had a 90% proximal lesion of the left anterior descending coronary artery, a 75% lesion in the proximal right coronary artery, and a 75% lesion in the mid circumflex artery.

Discussion of Case Study 1

In addition to the impact of HIV infection on the cardiovascular system, antiretroviral therapy also plays a role in cardiovascular disease. Specifically, protease inhibitors, including Ronald’s saquinavir with ritonavir regimen, have been associated with severe premature coronary disease. Persons living with HIV who are receiving protease inhibitors are at increased short-term risk for death and have a marked long-term risk for myocardial infarction and the need for coronary revascularization. In addition, protease inhibitors induce hyperlipidemia and insulin resistance, which are associated with atherogenesis. The cardiovascular effects of antiretroviral therapy are presented in Table 1. Because dyslipidemia in persons living with HIV plays an important role in atherogenesis and the progression of coronary artery disease, treating dyslipidemia is critical in slowing its damaging effects.

As the critical care nurse and other members of the health care team partner with Ronald to facilitate lifestyle modifications, including weight loss, diet modification, and exercise, they also consider the most effective pharmacological methods for managing the dyslipidemia. The goal is to maintain the current antiretroviral therapy regimen while optimizing the dyslipidemia regimen. Current guidelines for the treatment of

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**Table 1 Antiretroviral therapy classes, cardiac effects, and nursing implications**

<table>
<thead>
<tr>
<th>Class</th>
<th>Cardiac effect</th>
<th>Nursing implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonnucleoside reverse transcriptase inhibitor (efavirenz, emtricitabine)</td>
<td>Dyslipidemia(^{22}) Increased risk of cardiovascular events(^{23})</td>
<td>Must titrate to lowest dose of rosuvastatin and atorvastatin(^{22}) Must use highest dose of pravastatin(^{22}) Encourage diet and exercise to minimize additional risk factors for cardiovascular events</td>
</tr>
<tr>
<td>Protease inhibitor (atazanavir with ritonavir, saquinavir with ritonavir)</td>
<td>Dyslipidemia(^{22}) PR-interval prolongation(^{22}) QT-interval prolongation(^{22}) Higher risk of myocardial infarction(^{22})</td>
<td>Must titrate to lowest dose of rosuvastatin and atorvastatin(^{22}) Must use highest dose of pravastatin(^{22}) Observe patient’s cardiac monitor for rhythm changes Encourage diet and exercise to minimize additional risk of myocardial infarction</td>
</tr>
<tr>
<td>Integrase strand transfer inhibitor (raltegravir)</td>
<td>None known(^{22})</td>
<td>None known</td>
</tr>
<tr>
<td>Dual nucleoside reverse transcriptase inhibitor pairs (abacavir, tenofovir disoproxil fumarate, emtricitabine)</td>
<td>Increased risk of cardiovascular events(^{22})</td>
<td>Encourage diet and exercise to minimize additional risk factors of cardiovascular events</td>
</tr>
</tbody>
</table>
Many persons living with HIV require higher doses of statins to manage dyslipidemia. For Ronald, even the maximum dose of pravastatin (80 mg) is associated with a small risk for rhabdomyolysis, a life-threatening condition involving acute muscle breakdown leading to kidney failure. The risks and benefits of various statins used in conjunction with antiretroviral therapy are summarized in Table 2.

As the cardiac catheterization results indicated, Ronald has marked multivessel coronary artery disease. Because of the lesions, Ronald’s health care team is considering whether to perform a percutaneous coronary intervention with stent placement or a coronary artery bypass graft (CABG). Figure 1 provides a schematic flowchart of decision making in such situations. In patients without HIV infection, drug-eluting stents are preferred because the drugs inhibit cellular growth around the stent and reduce restenosis and the need for future revascularizations. In addition, compared with bare-metal stents, drug-eluting stents are associated with better outcomes within the first year; after 1 year, the risks for death and repeat revascularization are the same for both types of stent. However, persons living with HIV are more likely than HIV-negative persons to require recurrent revascularization, which is thought to be linked to elevated levels of C-reactive protein.

If Ronald were to have a stent placed, he would have to take aspirin indefinitely along with a P2Y12 (platelet aggregation) inhibitor such as clopidogrel, prasugrel, or ticagrelor for 1 year. Many times, in order to avoid development of gastric ulcers due to aspirin or a P2Y12 inhibitor, omeprazole is recommended. However, proton pump inhibitors like omeprazole reduce the production of stomach acid and decrease the effectiveness of antiretroviral drugs by increasing the pH of the gastric contents to a level too alkaline for absorption of antiretroviral agents. In order to avoid this situation, histamine₂-receptor antagonists, which do not create such an alkaline environment, are preferred. The antagonists have specific

<table>
<thead>
<tr>
<th>Statin</th>
<th>Cardiac effect</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pravastatin</td>
<td>No dose adjustment with saquinavir (however, need to use lowest dose with other protease inhibitors and highest dose with nonnucleoside reverse transcriptase inhibitors) Ability to increase/change dose Independent of cytochrome P450 metabolism</td>
<td>Rhabdomyolysis⁴⁴ Less effective in decreasing levels of low-density lipoprotein when used with protease inhibitor ART²²</td>
</tr>
<tr>
<td>Rosuvastatin</td>
<td>More effective in lowering levels of low-density lipoprotein compared with pravastatin because of bioavailability</td>
<td>Interact with metabolism of ART drugs via cytochrome P450 pathway²²²⁵ Always titrate to lowest possible dose²² Must monitor toxic effects of ART²²</td>
</tr>
<tr>
<td>Atorvastatin</td>
<td>More effective in lowering levels of low-density lipoprotein compared with pravastatin because of bioavailability</td>
<td>Interact with metabolism of ART drugs via cytochrome P450 pathway²²²⁵ Titrte to lowest possible dose (≤ 20 mg)²²²⁵</td>
</tr>
<tr>
<td>Pitavastatin</td>
<td>Highest bioavailability Fewer data on interaction with ART</td>
<td>No dose adjustments recommended when used with ART</td>
</tr>
<tr>
<td>Simvastatin</td>
<td>Contraindicated with ART</td>
<td>Contraindicated with ART</td>
</tr>
<tr>
<td>Lovastatin</td>
<td>Contraindicated with ART</td>
<td>Contraindicated with ART</td>
</tr>
</tbody>
</table>
coadministration recommendations for use with antiretroviral agents. Critical care nurses should know that antiretroviral agents should be administered 2 hours before or 10 hours after administration of histamine₂-receptor antagonists to optimize absorption of agents used in antiretroviral therapy.

Another option to manage Ronald’s multivessel disease is CABG. According to the American College of Cardiology/American Heart Association practice guideline, surgical intervention is favored over percutaneous coronary intervention for patients with multivessel coronary artery disease and has higher survival benefits for patients with proximal lesions of the left anterior descending coronary artery (Figure 1). In a study with stratification for HIV status of patients with multivessel coronary artery disease who had CABG, outcomes were similar for HIV-negative patients and patients living with HIV immediately postoperatively. These outcomes included similar rates of myocardial infarction, stroke, mediastinitis, and reintervention. However, long-term follow-up revealed that persons living with HIV had an increased need for repeat revascularizations. In Ronald’s case, the recommended procedure would be CABG.

**Contractility-Related Cardiovascular Disease and HIV Infection**

Ronald’s case is an example of disease progression and treatment in a person living with HIV who has dyslipidemia and coronary lesions. However, another cardiac problem experienced by persons living with HIV is HIV-induced cardiomyopathy, which occurs in 10% to 20% of persons living with HIV. Dilated cardiomyopathy is the most common clinical manifestation in those living with HIV. It is defined as an ejection fraction less...
than 40% with increased left ventricular dimensions when adjustments are made for body surface area.33

The pathophysiological basis of cardiomyopathy among those living with HIV is linked to the actions of cytokines and autoantibodies. The presence of HIV in the myocardium is associated with an increase in cytokines and cardiomyocyte apoptosis (programmed cell death) through signaling via the receptors CCR3, CCR5, and CXCR4.34 These chemokine receptors are involved in different parts of the immune response and can signal for apoptosis of cells recognized as foreign when the immune cascade is triggered. Additionally, glycoprotein 120, part of the core envelope gene of HIV, may also induce cardiomyocyte apoptosis through a mitochondrially controlled pathway involving the activation of inflammatory cytokines. Further, tumor necrosis factor α may decrease inotropy by failing to induce intracellular calcium influx and inducing the production of nitric oxide synthase, resulting in left ventricular dysfunction.34

Theories have linked HIV-induced cardiomyopathy with both encephalopathy and toxic drug effects. Persons living with HIV who have encephalopathy are more likely to die of congestive heart failure than are those without encephalopathy, suggesting a relationship between the two. In both conditions, reservoir cells in the myocardium and cerebral cortex hold on to HIV-1 on their surfaces long after antiretroviral therapy has lowered plasma viral load. This retention results in the chronic release of tumor necrosis factor α, interleukin-6, and endothelin-1, leading to progressive tissue damage, encephalopathy, and cardiomyopathy.34 Similarly, myocarditis can lead to the release of functional cytokines, including tumor necrosis factor α and interleukin-6, and nitric oxide synthase, leading to myocardial damage and dysfunction associated with cardiomyopathy.34

Figure 2 provides a synthesis of the discussed linkages between biomarkers, HIV, and the resulting pathophysiological changes.

Exemplar Case Study 2

The following case study describes clinical care management of Elmer, a 50-year-old man who has been living with HIV for 16 years. He has been prescribed antiretroviral therapy since his diagnosis, but his struggle to adhere to the therapy has necessitated several changes in the regimen. His current therapy is the preferred protease inhibitor-based regimen, which includes atazanavir with ritonovir, emtricitabine, and tenofovir disoproxil fumarate. Because of Elmer’s difficulty with adherence, this treatment is optimal because it requires once-a-day dosing with a small number of pills.

In addition to HIV infection, Elmer has a history of cocaine use. He began using cocaine when he was 23
years old and relapsed 2 years ago. He currently snorts cocaine when available but often smokes or injects crack cocaine because crack cocaine is easily accessible and less costly than other forms of the drug. His injection drug use contributed to a previous diagnosis of infective endocarditis of the tricuspid valve.

Elmer now comes to the emergency department because of chest pain that is not relieved at rest. He has had marked dyspnea on exertion for the past 2 weeks. A blood test reveals nonelevated levels of troponin when he arrives in the department and at 6 and 9 hours later, ruling out myocardial infarction. A 12-lead electrocardiogram reveals an absence of discrete P waves and an irregular rhythm, suggesting atrial fibrillation. A diagnostic cardiac catheterization is performed and reveals nonischemic cardiomyopathy attributed to a history of cocaine use and HIV infection. Results of a chemistry panel include creatinine level 1.9 mg/dL (to convert to micromoles per liter, multiply by 88.4) and urea nitrogen concentration 45 mg/dL (to convert to millimoles per liter, multiply by 0.357), suggestive of renal insufficiency. Elmer is admitted to the cardiac care unit after the cardiac catheterization. Shortly after admission to the unit, Elmer experiences an episode of atrial fibrillation with a rapid ventricular rate.

Discussion of Case Study 2

Managing Elmer’s care requires considering several competing priorities. His care team must focus on mitigating the risk for stroke due to atrial fibrillation, minimizing workload of the heart while maximizing cardiac output, and monitoring for drug interactions and toxic effects, all while maintaining his current antiretroviral therapy regimen.

The medical providers consider ibutilide, amiodarone, digoxin, and β-blockers to manage the atrial fibrillation. Amiodarone is an antiarrhythmic agent that can be used for rate control in atrial fibrillation when other agents are ineffective or cannot be administered. Unfortunately, amiodarone has a long half-life (mean, 58 days) and severe interactions with the medications used in antiretroviral therapy.22 Further, inhibition of metabolism via the cytochrome P450 pathway by antiretroviral agents (specifically, atazanavir and emtricitabine) leads to increased serum levels of amiodarone, resulting in the potential for hypotension, bradycardia, and more cardiac arrhythmias.41 Because of increased serum levels of amiodarone, the risks of toxic effects due to amiodarone outweigh the benefits of managing the atrial fibrillation with this drug. Further, because of previous nonadherence to medications that resulted in HIV genotypic resistance to some antiretroviral agents, Elmer must maintain his current antiretroviral therapy regimen because few other options for treating HIV infection exist. Therefore, amiodarone is not an appropriate treatment for atrial fibrillation for Elmer.

Digoxin is a possible antiarrhythmic alternative to amiodarone to treat the atrial fibrillation because it is not contraindicated with use of antiretroviral therapy. However, digoxin has a narrow therapeutic index and can interact with some antiretroviral medications, resulting in higher or lower levels of serum digoxin, depending on the specific antiretroviral therapy regimen. Therefore, serum digoxin levels must be closely monitored to stay within the therapeutic range (0.5-0.8 mg/dL).25 Additionally, dosing of digoxin along with Elmer’s antiretroviral medications is complicated by renal insufficiency and concern for toxic effects. Digoxin is 50% to 70% cleared by the kidneys, resulting in a significantly longer half-life in patients with renal problems.32 Elmer’s renal insufficiency and the effect of his antiretroviral drugs on serum levels of digoxin must be considered in the initial dosing and maintenance of digoxin. Because of the renal insufficiency, the digoxin loading dose would have to be decreased by one-half and the maintenance dose reduced to 125 μg once daily. Because serum levels of digoxin are unpredictable when administered to a patient receiving antiretroviral therapy and because renal insufficiency puts Elmer at high risk for toxic effects due to digoxin, this antiarrhythmic agent is also not an appropriate treatment for the atrial fibrillation.

The third option for treating the atrial fibrillation is a β-blocker. This class of medication has no listed interactions with antiretroviral drugs and could regulate the atrial fibrillation with the lowest chance of toxic effects.22 Although β-blockers are safe with Elmer’s antiretroviral therapy regimen, not all are safe because of the renal insufficiency. Some β-blockers such as metoprolol and...
atenolol are primarily excreted through the kidneys. Therefore, the critical care nurse should work with the multidisciplinary team to ensure that a non-renal cleared β-blocker, such as carvedilol, is prescribed.

Because Elmer has cardiomyopathy, which is exacerbated by atrial fibrillation, he has a risk for embolic stroke that can be reduced by using anticoagulants such as dabigatran, warfarin, apixaban, or rivaroxaban (Table 3). Apixaban and rivaroxaban are newer medications, and their interactions with antiretroviral drugs are unknown, and so they would not be recommended for Elmer. Dabigatran is indicated to prevent stroke and systemic embolization in patients who have nonvalvular atrial fibrillation and at least 1 additional risk factor for stroke. Dabigatran is more effective than warfarin in the prevention of embolic stroke in patients with atrial fibrillation and requires markedly less monitoring than does warfarin because of more predictable serum levels. Thus, dabigatran may be most beneficial considering Elmer’s history of nonadherence to medications prescribed. However, safe dosing of dabigatran in patients with renal insufficiency is unclear. Because Elmer has an elevated ratio of urea nitrogen to creatinine, renal clearance is an important consideration. Dabigatran is excreted primarily through the kidneys, whereas warfarin is metabolized primarily through the cytochrome P450 pathway. Decreased renal clearance leading to toxic effects of dabigatran could result in bleeding complications, and although dabigatran does have more predictable serum levels than does warfarin, because no method of monitoring and no antidote for the former drug are available, the risk of toxic effects could outweigh the benefits in someone with compromised kidney function. Thus, although dabigatran is more effective in stroke prevention, warfarin is a better choice for Elmer because of the renal insufficiency.

**Conclusion**

Critical care nurses who manage care for patients such as Ronald and Elmer must understand the complex pathophysiology of cardiovascular disease among persons living with HIV. Further, when administering medications, nurses must remember that protease inhibitors inhibit P450 CYP3A4, a situation that could result in toxic effects due to the drugs. Similarly, nurses must consider the effect of P2Y12 (platelet aggregation) inhibitors on the absorption of antiretroviral agents. Because high-level compliance with medications is essential in HIV treatment, unnecessary changes in an antiretroviral therapy regimen should be avoided. Overall, nurses play an important role in preventing interactions between antiretroviral agents and other medications, optimizing the effectiveness of antiretroviral therapy and preventing avoidable toxic effects.

As illustrated in both case studies, care of persons living with HIV involves considering competing priorities of care. Pharmacological considerations, in particular, require frequent reference to the compatibility of coadministered drugs, drug dosing information, and management of signs and symptoms. In case study 1, the factors influencing decision making for managing coronary artery disease in a person living with HIV are

<table>
<thead>
<tr>
<th>Medication</th>
<th>Pro</th>
<th>Con</th>
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<tbody>
<tr>
<td>Dabigatran</td>
<td>Less coagulation monitoring&lt;sup&gt;43&lt;/sup&gt;</td>
<td>Primary renal clearance&lt;sup&gt;25&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>No known interaction with antiretroviral therapy (ART)&lt;sup&gt;22&lt;/sup&gt;</td>
<td>Limited data on dosage for renal insufficiency</td>
</tr>
<tr>
<td></td>
<td>Worse outcome: toxic effects of dabigatran and bleeding complications</td>
<td>No antidote</td>
</tr>
<tr>
<td>Warfarin</td>
<td>Less renal clearance&lt;sup&gt;25&lt;/sup&gt;</td>
<td>Regular coagulation monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unpredictable interaction with ART medications&lt;sup&gt;22&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Metabolism via cytochrome P450 pathway&lt;sup&gt;25&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Worst outcome: not effective and embolic stroke</td>
</tr>
<tr>
<td>Apixaban</td>
<td>Less coagulation monitoring</td>
<td>Limited data on interaction with ART medications</td>
</tr>
<tr>
<td></td>
<td>Less renal clearance</td>
<td>Worse outcome: unfavorable interaction with ART medications</td>
</tr>
<tr>
<td>Rivaroxaban</td>
<td>Less coagulation monitoring</td>
<td>Limited data on interaction with ART medications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primarily renal clearance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Worse outcome: unfavorable interaction with ART medications</td>
</tr>
</tbody>
</table>
examined. This case study illustrates the complex pharmacological management after a stent placement in a patient receiving antiretroviral therapy and factors that influence surgical intervention. In case study 2, complex issues in managing drug therapy options for a patient with atrial fibrillation are examined. Critical care nurses must understand the risk factors and pathophysiological changes to help provide patient education and collaborate with the other members of the interprofessional team. Further, nurses must consider the complex pharmacological issues between antiretroviral therapy and anti-lipemics, antiarrhythmics, and anticoagulants. CCN

Financial Disclosures
None reported.

dotmore

To learn more about caring for patients with HIV in the intensive care unit, read "Pharmacological Considerations in Human Immunodeficiency Virus–Infected Adults in the Intensive Care Unit" by DeFreitas et al in Critical Care Nurse, April 2013;33:46-56. Available at www.ccnonline.org.

References


HIV infection has progressed from an acute, terminal disease to a chronic illness with cardiovascular disease as the leading cause of death among persons living with HIV. As persons living with HIV infection continue to become older, traditional risk factors for atherosclerosis compounded by the pathophysiological effects of HIV infection and antiretroviral therapy markedly increase the risk for cardiovascular disease. Critical care nurses must recognize the risk factors for cardiovascular disease and the pathophysiology and complex treatment options in order to manage care of these patients and facilitate multidisciplinary collaboration.

- As a consequence of HIV infection, both atherogenesis and endothelial dysfunction are accelerated, increasing the risk for cardiovascular events.
- In all populations, atherogenesis is an inflammation-mediated process. Among persons living with HIV, atherogenesis is accelerated because of a constant proinflammatory state that exists throughout the lifetime of the infected person, even during antiretroviral therapy.
- Theories have linked HIV-induced cardiomyopathy with both encephalopathy and toxic drug effects.
- The Figure provides a synthesis of the discussed linkages between biomarkers, HIV, and the resulting pathophysiological changes.
- Because high-level compliance with medications is essential in HIV treatment, unnecessary changes in an antiretroviral therapy regimen should be avoided. Overall, nurses play an important role in preventing interactions between antiretroviral agents and other medications, optimizing the effectiveness of antiretroviral therapy and preventing avoidable toxic effects.

Figure  Schematic illustration of HIV-induced atherogenesis and cardiovascular disease.
Hybrid stage I palliation combines cardiothoracic surgery and interventional transcatheter procedures for treatment of hypoplastic left heart syndrome. The approach is an alternative to the Norwood procedure, the traditional first stage of surgical palliation. Hybrid stage I palliation involves placing bilateral branch pulmonary artery bands and a patent ductus arteriosus stent through a median sternotomy, performed without cardiopulmonary bypass. The purpose of the bands is to control blood flow to the lungs and protect the pulmonary bed while the stent sustains systemic cardiac output. A balloon atrial septostomy is performed to create an atrial septal defect for unobstructed blood flow from the left atrium to the right atrium. The second stage of palliative surgery is the comprehensive stage II, which incorporates removal of the stent and pulmonary artery bands, atrial septectomy, anastomosis of the diminutive ascending aorta to the main pulmonary artery, aortic arch augmentation, and bidirectional cavopulmonary anastomosis. The traditional Fontan procedure completes the series of palliation. (Critical Care Nurse. 2016;36(5):48-55)

The hybrid stage I procedure (Figure 1) is an alternative, lower risk palliation for newborns with hypoplastic left heart syndrome (HLHS) and has been previously described. The hybrid procedure, unlike the traditional Norwood procedure or Norwood variation, avoids cardiopulmonary bypass, circulatory arrest, and associated surgical risks early in the neonatal period. Use of the hybrid procedure transfers the major open heart surgery, including the risks associated with cardiopulmonary bypass, to early infancy, usually between 4 to 6 months of age; the premise is that cardiopulmonary bypass will be better tolerated at that age.
Anatomy and Physiology

The diagnosis of HLHS may include aortic atresia with mitral atresia, aortic atresia with mitral stenosis, or aortic stenosis with mitral stenosis. Cardiac output is primarily, if not completely, dependent on the patent ductus arteriosus (PDA). The right ventricle is the systemic pumping chamber; it pumps blood across the pulmonary valve to the main pulmonary artery, through the right and left pulmonary arteries to both lungs, and across the PDA to the systemic circulation. The ductus arteriosus is kept patent by intravenous infusion of prostaglandin E1. During the first several weeks of life, the pulmonary artery resistance decreases, resulting in pulmonary overcirculation.

During retrograde perfusion of the aortic arch, oxygenated blood flows from the PDA backward to the aortic arch, carotid arteries, ascending aorta, and coronary arteries. This retrograde flow is the only source of oxygenated blood to the heart and to the brain for neonates with HLHS who have aortic atresia rather than aortic stenosis. Underperfused myocardium can result in ischemia and changes in electrocardiographic findings.

The atrial septal defect (ASD) allows unobstructed blood flow to return from the lungs to the left atrium and across the ASD. If the defect becomes smaller and more restrictive, the pressure difference increases in the left atrium and in turn may create pulmonary hypertension and signs of congestive heart failure. The first stage of palliation, whether the Norwood procedure or the hybrid procedure, establishes dependable systemic blood flow, limits pulmonary overcirculation, and provides unobstructed blood flow across the atrial septum.

Technique

Hybrid stage I palliation combines cardiothoracic surgical and interventional transcatheter techniques for treating HLHS during the same operative procedure and operative setting. This management approach, typically performed within the first week of life, involves placing pulmonary artery bands (PABs) on both branches of the artery and a PDA stent through a median sternotomy on the beating heart, without cardiopulmonary bypass. A balloon atrial septostomy is performed, either during this procedure or at a later date, to create an adequate-sized ASD or opening between the left and right atria, to allow unobstructed blood flow returning from the lungs to the left atrium to shunt across the ASD to the right atrium.

After a median sternotomy, the cardiothoracic surgeon places a 1- to 2-mm–wide synthetic vascular graft (Gore-Tex band; W. L. Gore & Associates Inc), approximately 3.0 to 3.5 mm in diameter, around the proximal left and right pulmonary arteries. This step is followed by placement of either a self-expandable or a balloon-expandable stent in the PDA by the interventional cardiology team. The stent is placed through a sidearm sheath that is placed approximately 2 mm into the main pulmonary artery after direct puncture and secured with a purse string suture. A small amount of contrast material is injected through the sidearm of the sheath to delineate the anatomy of the PDA, descending aorta, and retrograde aortic arch. Appropriate measurements of the PDA at
the pulmonary entrance, mid ductus, and distal ductus, along with ductal length, are obtained to determine the size and type of stent. If any evidence of stenosis is detected, a balloon-expandable stent is used. If no stenosis is present, an alternative is to use a self-expanding stent. The key is to ensure that the entire length of the ductus is covered by the stent to prevent the ductal tissue from closing and becoming stenotic. Once the PDA stent is in place, the infusion of prostaglandin E1 can be discontinued. An alternative to placing a stent in the PDA is to continue infusion of prostaglandins after placement of the PABs as a bridge to the Norwood procedure. Creating an adequate-sized ASD or larger hole between the right and left atria, usually via balloon atrial septostomy finalizes stage I palliation. Occasionally, a stent is required to ensure an adequate ASD, particularly if the septum is thick or balloon atrial septostomy is not successful.

Postoperative Course

The immediate postoperative course in a neonate who has had a Norwood procedure differs markedly from the postoperative care after a hybrid procedure. Compared with a Norwood procedure, the hybrid procedure is associated with shorter time to extubation, fewer blood transfusions, initiation of enteral feedings, and shorter stays in the intensive care unit and hospital. However, whether or not oxygenation and perfusion to the brain after a hybrid procedure are adequate, because of the persistent retrograde aortic blood flow, remains to be answered. Galantowicz et al reported that 52% of patients were extubated in the operating room after a hybrid procedure, and 85% were extubated within 24 hours. Inotropic support was not required in any patient, and 79% of patients were feeding within 24 hours. No patient required extracorporeal membrane oxygenation or delayed sternal closure. Hospital survival to discharge was 97.5%, mean length stay of in the cardiothoracic intensive care unit was 4.5 days, and mean postoperative hospital length of stay was 13 days. Interstage medications after placement of the PDA stent may include aspirin, furosemide, digoxin, or enalapril.

Much of the postoperative nursing care focuses on monitoring vital signs and oxygen saturation and assessing for signs of respiratory distress. Arterial blood gases and electrolytes and lactate levels are monitored in the initial postoperative period; the results inform postoperative management. Other aspects of nursing care after a hybrid stage I palliation are pain management, wound care, and growth and nutrition (parenteral and enteral). Nurses should observe patients for signs of feeding intolerance (ie, decreased oral intake), increased work of breathing with retractions, tachypnea, diaphoresis, and lack of weight gain. Any changes should be reported to the medical team.

Growth and Nutrition

The focus of the National Pediatric Cardiology Quality Improvement Collaborative of the Joint Council on Congenital Heart Disease has been on decreasing interstage mortality. Although preoperative enteral feedings have been controversial, the collaborative feeding group has established algorithms and feeding guidelines for single-ventricle patients. Total parenteral nutrition is recommended, with advancement to full caloric intake of 90 to 100 kcal/d. Amino acids should be started at 1.5 to 3 g/kg per day and increased by 1 to 1.5 g/kg per day to a maximum of 3 g/kg per day. Lipids should be started at 1 to 3 g/kg per day and increased by 0.5 to 1 g/kg per day to a maximum of 3 g/kg per day. Adequate caloric goals can be met during interstage monitoring, regardless of the feeding technique. Initiation of enteral feeding is strongly recommended if the patient’s hemodynamic status is stable, regardless of use of an umbilical catheter or prostaglandin E1 infusion. A nasogastric feeding tube may be used; however, the collaborative group has made no specific recommendation on this practice. The goal is to eventually reach a feeding volume of 120 to 140 mL/kg per day and 120 to 150 kcal/kg per day.

Advantages and Disadvantages

The major advantages of the hybrid stage I procedure include avoiding cardiopulmonary bypass, circulatory arrest, and the associated risks of open heart surgery in the neonatal period. Other advantages include early extubation, no need for inotropic support, no blood transfusion, decreased intensive care length of stay, and early feedings. Hybrid stage I palliation can be performed on premature babies weighing less than 2.5 kg. Neonates weighing less than 2 kg have successfully undergone hybrid stage I palliation. However, these extremely
premature babies remain at risk for other comorbid conditions associated with prematurity, such as necrotizing enterocolitis. Schranz et al reported an 84% survival at 1 year for children with HLHS who underwent the hybrid procedure, with a 15-year survival rate of 77%. Risk factors of low birth weight or aortic atresia did not affect the 15-year outcome data.

Some institutions reserve the hybrid stage I procedure for extremely high-risk patients (ie, infants who weigh less than 2.5 kg or have other comorbid conditions such as extreme prematurity) who would otherwise be extremely high risk for mortality with the Norwood procedure. Doing so may be considered an advantage in terms of weight, or a disadvantage because high-risk patients may have the highest risk for mortality. Other disadvantages include the need for close monitoring, possibly every 2 weeks. This monitoring need may be an added burden for the patient’s family, particularly if they do not live locally and must travel for outpatient clinic appointments. Families may spend hours at each outpatient visit for complete assessment by a interprofessional team.

Discharge and Home Monitoring

The nursing team should help coordinate provision of appropriate therapies, such as occupational, physical, and speech therapies. Nurses also play an important role in educating and supporting patients’ families in at-home care of the infant and this complex anatomical lesion. Before an infant is discharged from the hospital, parents and caregivers may need education and instructions on tube feedings, signs of respiratory distress, and cardio-pulmonary resuscitation. Members of the nursing team help coordinate discharge planning and follow-up, alerting community emergency units and the pediatrician of the infant’s status and planned discharge. Nurses are key in the coordination of care to help achieve the best outcomes.

Home monitoring for patients with a single ventricle has been reported. Infants with HLHS who have had hybrid stage I palliation need to be closely monitored after hospital discharge. Incorporating a home-monitoring program after either hybrid or Norwood stage I palliation is recommended. Parents or caregivers should monitor the infant’s daily caloric intake by recording daily formula intake, daily weight, and daily oxygen saturation (via pulse oximetry) to evaluate for potential complications. Such monitoring may lead to a marked decrease in mortality. Data are generally reported to the home-monitoring nurse on a weekly basis. Parents are instructed when to call if a deviation from the established criteria occurs to determine whether further clinical assessment or possible hospitalization is warranted. At Nationwide Children’s Hospital, Columbus, Ohio, outpatient visits for patients with a single ventricle include a careful feeding history, review of home-monitoring data, physical examination, an electrocardiogram, and an echocardiogram at each visit. Additionally, patients are evaluated by a nutritionist and by an occupational or a physical therapist or both.

For HLHS patients who have feeding difficulty or increased cyanosis or whose findings on surveillance echocardiography are a concern, closer observation is required. Physical examination in the outpatient cardiology clinic should include measurement of blood pressure in the upper and lower extremities (both arms and at least 1 leg), along with examination of right brachial and femoral pulses to check for signs of retrograde aortic arch obstruction or evidence of coarctation of the descending aorta. Both echocardiograms and electrocardiograms should be obtained and should be compared with previous findings.

During the interstage period, growth and nutrition must be assessed continually, and nurses play a key role in the assessment. Monitoring should include daily weight and total 24-hour volume and caloric intake of feedings; the goal is a weight gain of 20 to 30 g/d. As part of the home-monitoring program, a lack of success in reaching these nutritional guidelines is indicated by weight loss greater than 30 g in 1 day, failure to gain 20 g in 3 days, and intake less than 100 mL/kg per day. Such changes may prompt an assessment by the cardiology team and possible hospital admission.

A registered dietician is a vital part of the interprofessional management team for patients with HLHS and should be involved in all nutritional assessments and issues. Miller-Tate et al reported a mean interstage weight gain of 16.85 g/d (SD, 5.94 g/d) in HLHS patients with feeding difficulty or increased cyanosis or whose findings on surveillance echocardiography are a concern, closer observation is required. Physical examination in the outpatient cardiology clinic should include measurement of blood pressure in the upper and lower extremities (both arms and at least 1 leg), along with examination of right brachial and femoral pulses to check for signs of retrograde aortic arch obstruction or evidence of coarctation of the descending aorta. Both echocardiograms and electrocardiograms should be obtained and should be compared with previous findings.
patients who underwent the hybrid stage I procedure at a mean of 6.12 months (SD, 1.37 months) of age. The mean weight \( z \) score before stage II was -2.25 (SD, 1.28). Patients who received home monitoring had significantly higher weight \( z \) scores (mean, -1.67; SD, 0.98) compared with patients without home monitoring (mean, -2.82; SD 1.28). These interstage weight gains are comparable to gains after the Norwood procedure. Regardless of the type of palliation, home-monitoring programs and feeding protocols have significantly improved outcomes in growth and nutrition.

Nurse-managed home-monitoring programs are helpful in providing support to patients’ families while monitoring the patients’ nutrition, weight gain, oxygen saturations, and respiratory status. Caring for an infant with HLHS at home and monitoring the infant’s growth and respiratory status can be quite burdensome for the infant’s family members and are often highly stressful. Much support is needed for families of infants with HLHS, from social service personnel, nurses, registered dieticians, occupational and speech therapists, physical therapists, and the team of cardiologists and the cardiothoracic surgeon. Meetings with parents and the home-monitoring team via the computer applications FaceTime or Skype may help alleviate some anxiety and give the care team a better assessment of the infant’s status.

**Concerns During the Interstage Period**

The interstage period between hybrid stage I and surgical comprehensive stage II procedures is associated with many risk factors. Infants in this stage reach their nadir in hemoglobin levels, and their oxygen-carrying capacity may be at the lowest. Major limitations of the hybrid procedure are the persistent cerebral and myocardial perfusion during the first several months of life and the potential risk for retrograde aortic arch obstruction resulting in decreased cerebral and myocardial oxygenated blood flow. Decreased cerebral and myocardial perfusion may be devastating if not monitored closely and if appropriate interventions are not done in a timely fashion. Other problems may also arise during the interstage period, including an increased gradient across the ASD, intimal proliferation causing in-stent stenosis in the PDA stent, or recoarctation distal to the PDA stent. All of these require urgent intervention, such as creation of a larger ASD or possibly stent placement in the atrial septum, coaxial stent placement in the PDA stent, or stenting of the retrograde aortic arch. Any of the complications may increase morbidity and mortality after the hybrid procedure. Obstructed lesions that cause retrograde aortic arch stenosis may have serious deleterious effects on coronary artery perfusion and right ventricular function and could result in death if not treated in a timely manner. The incidence of retrograde aortic arch obstruction in HLHS patients during the interstage period can be as high as 29%. Predictors of retrograde aortic arch obstruction in HLHS infants after the hybrid procedure can include increased angle of the aortic isthmus to the PDA. Any indications of obstruction or decreased right ventricular function should prompt a discussion because these complications may necessitate hospitalization, cardiac catheterization with intervention, or earlier than planned surgical palliation.

**Indications for Cardiac Catheterization**

In infants who have had the hybrid stage I procedure, echocardiographic indications of a decrease in qualitative right ventricular function or an increase in the degree of tricuspid regurgitation or both are often associated with obstruction and require close interim follow-up. Any electrocardiographic evidence of continued or marked decrease or new ST-T wave changes or an increase in retrograde aortic arch velocity may require hospital admission and consideration of cardiac catheterization. Any abnormal diastolic flow pattern may indicate an increase in distal pulmonary artery pressure and development of pulmonary vascular resistance. Overall, echocardiographic assessment is vitally important. However, echocardiography is limited for grading the degree of function, which is a subjective finding, or for assessing for in-stent stenosis due to intimal proliferation. The latter is not evident on echocardiograms. Evidence of acceleration of blood flow on Doppler imaging is indicative of stenosis, which may cause obstruction of blood flow. Often, a team discussion of a strategic plan is beneficial, particularly in terms of cardiac catheterization and intervention (eg, conversion to a Norwood stage I procedure or possibly an early stage II palliation).
Comprehensive Stage II Procedure

The second-stage reconstruction after hybrid stage I palliation is referred to as the comprehensive stage II procedure (Figure 2). This reconstruction is considered the big open heart surgery for the staged palliation. Essentially, the surgery involves part of the traditional Norwood procedure, as well as the second stage palliation. The comprehensive stage II procedure incorporates removal of the PDA stent and PABs, excision of the atrial septum, anastomosis of the diminutive ascending aorta to the main pulmonary artery, augmentation of the aortic arch, and a cavopulmonary anastomosis. Therefore, this second-stage palliation involves prolonged duration of cardiopulmonary bypass. This prolonged duration must be carefully considered when the hybrid path is taken.

Timing of this second-stage procedure may be influenced by the retrograde aortic arch blood flow or recoarctation or both. Pulmonary artery pressures may also influence timing for a cavopulmonary anastomosis. High pulmonary artery pressures may result in increased cyanosis in anatomical regions with passive venous blood flow with the cavopulmonary anastomosis. The comprehensive stage II procedure is usually performed when the infant is 6 months old. However, the idea that cardiopulmonary bypass and the associated risks of a major open heart surgery are better tolerated at 4 to 6 months of age than during the neonatal period has not been proved. If an HLHS requires an early comprehensive stage II procedure, within the first few months after the hybrid stage I, a better alternative may be conversion to a traditional Norwood procedure. However, both conversion to a stage I Norwood procedure and an early comprehensive stage II procedure may be practical options, depending on the age and weight of the patient, particularly if the infant has systemic outflow obstruction.

Angiography performed before cardiopulmonary bypass is stopped and the chest is closed is recommended to evaluate the cavopulmonary connection and branch pulmonary artery flow. The angiography can be performed by using a portable C-arm for fluoroscopic imaging and inserting an angiographic catheter directly into the superior vena cava, temporarily stopping or decreasing blood flow in the cardiopulmonary bypass circuit, and using a power injector to deliver the contrast material for imaging. The results of angiography may indicate a need for immediate therapy, either surgical or transcatheter. The angiographic findings are also helpful during the postoperative management period and allow for possible plans for future early assessment or intervention via cardiac catheterization. An alternative option for obtaining an angiogram may be a surveillance cardiac catheterization, particularly if the patient continues to require ventilatory support in the postoperative period.

Fontan Procedure

The Fontan procedure is the third and final stage of reconstruction in patients with HLHS and is essentially the same operation for children born with the syndrome who have the traditional Norwood staged procedure. The Fontan procedure is the total cavopulmonary connection in which the inferior vena cava is now anastomosed to the pulmonary artery. In general, the risks are low for complications associated with the Fontan procedure; however, pulmonary artery pressures are an important variable.
Developmental Outcomes

Neurocognitive development and long-term outcomes in HLHS patients who were initially palliated by hybrid stage I and comprehensive stage II procedures are unknown at this time, and published reports on the topic are limited. In one study, mortality at 1 year of age in patients with HLHS and other univentricular heart defects who underwent hybrid stage I palliation (n = 9) did not differ significantly from that of patients who had the Norwood procedure (n = 11). Additionally, the psychomotor development index and mental development index scores were similar in the hybrid and Norwood groups, and significantly lower in both groups than in normal healthy 1-year-olds. Similar to findings in previous developmental studies in children who had a Norwood palliation, motor impairment was high. In another study, infants with HLHS who underwent hybrid stage I palliation and normal, healthy, age-matched controls were compared. The HLHS group scored lower than the control group in motor skills, language, and cognitive development as indicated by scores on the Bayley Scales of Infant and Toddler Development. However, only scores for motor skills were significantly lower in the HLHS group (P = .049). More research is needed to determine longer term outcomes.

Conclusion

Hybrid stage I palliation is an alternative to the Norwood procedure for treatment of infants with HLHS. In the neonatal period, compared with the Norwood procedure, the hybrid procedure has several benefits, such as avoiding use of cardiopulmonary bypass and the systemic effect of the inflammatory process. Initially after surgery, patients who have the hybrid procedure generally require little intensive care support, unless they have other comorbid conditions. Once the patient is discharged, the home-monitoring team becomes an integral part of the infant’s care. Frequent monitoring and echocardiographic imaging with a complete comprehensive evaluation at an interprofessional outpatient clinic every 1 to 2 weeks are common. Patients who have had the hybrid procedure are vulnerable during this interstage period. Inherent potential risks include development of PDA in-stent stenosis, retrograde aortic arch obstruction, possible recoarctation of the aorta at the distal PDA stent, and a restrictive atrial septum. If any of these risks actually occur, then surgical or transcatheter interventions, or even a conversion to a Norwood palliation, may be required. The comprehensive stage II procedure, usually performed after the hybrid stage I procedure when the patients are 4 to 6 months old, is the big open heart surgical palliation that involves a prolonged duration of cardiopulmonary bypass. Although not proved, the premise is that the patient may better tolerate cardiopulmonary bypass later in infancy than in the early neonatal period.

The hybrid approach may not be appropriate for all neonates born with HLHS or for all institutions. Some institutions reserve this approach for extremely high-risk neonates, whereas others routinely or exclusively use the hybrid stage I procedure. The hybrid procedure has been used as a high-risk salvage procedure in neonates who are in extremis after a late diagnosis. It can also be performed as a bridge to transplant or 2-ventricle repair or as a bridge to the Norwood procedure. For standard-risk HLHS infants, outcomes after hybrid stage I procedure are comparable to outcomes after a Norwood procedure. Information on longer term outcomes is needed to determine which cohort of babies born with HLHS may benefit most from the hybrid procedure.

Acknowledgments

Drs Mark Galantowicz and John P. Cheatham were instrumental in paving the way and perfecting the hybrid approach to treating HLHS.

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None reported.

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References


22. Hehir DA, Cooper DS, Walters EM, Ghanayem NS. Feeding, growth, nutrition, and optimal interstage surveillance for infants with hypoplastic left heart syndrome. Cardiol Young. 2011;21(suppl 2):S9-64.


Ethics

Clarification and Mitigation of Ethical Problems Surrounding Withdrawal of Extracorporeal Membrane Oxygenation

Susan B. Williams, BSN, RNC-NIC
Michael D. Dahnke, PhD

Extracorporeal membrane oxygenation (ECMO) is temporary life-support technology that provides time to rest the cardiac and respiratory system of critically ill people with acute, reversible medical conditions. Health care providers face emotional and challenging situations, where death may result, when withdrawing ECMO. A deepening of understanding of the ethical issues involved can aid clinicians in handling such difficult situations, leading to a possible mitigation of the moral problems. Toward this end, the ethical issues raised in the consideration of ECMO withdrawal are analyzed with respect to the ethical principles and concepts of autonomy, nonmaleficence/beneficence, medical futility, moral distress, and justice. In particular, these issues are considered in relation to how they affect and can be addressed by staff nurses and advanced practice nurses in the intensive care unit. Advanced practice nurses in particular can represent the voice of nurses to promote a healthier workplace in situations of moral distress related to stopping ECMO life-support technology and in developing clear and consistent guidelines for ceasing ECMO treatment, all leading toward clarification and mitigation of the ethical problems surrounding the withdrawal of this critical technology. (Critical Care Nurse. 2016;36[5]:56-65)

Extracorporeal membrane oxygenation (ECMO) is life-support technology that temporarily supports critically ill people with acute, reversible, life-threatening cardiac and/or respiratory conditions, allowing the failing heart and/or lungs to rest, heal, and recover over a period of days, weeks, or potentially months. This mode of technology is lifesaving for many people with acute cardiovascular and/or respiratory conditions that are reversible after organ rest, but ECMO technology

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This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Offer suggestions for change to mitigate ethical conflicts of extracorporeal membrane oxygenation (ECMO) withdrawal
2. Identify and analyze the ethical conflicts that arise with the use of ECMO, particularly conflicts involved in withdrawal of this technology
3. Explore the nurse’s role in dealing with ethical conflicts regarding withdrawal of ECMO

To complete evaluation for CE contact hour(s) for test #C165, visit www.ccnonline.org and click the “CE Articles” button. No CE test fee for AACN members. This test expires on October 1, 2019.

CE 1.0 hour
does not guarantee survival. Sometimes, patients receiving ECMO support develop conditions that this technology will not resolve and death becomes inevitable. At this point, ECMO may be perceived as futile treatment. However, the concept of medical futility is one fraught with ambiguity and dispute among various parties and perspectives. This ambiguity then leads to ethical conflict and moral distress when ECMO providers on the health care team, including staff nurses and advanced practice nurses (APNs), become frustrated and experience conflict between a duty to provide requested treatment and the possibility of providing merely nonbeneficial or even harmful interventions (eg, ones causing deterioration of the body and
decompenation of organ systems, as well as complications indicated in Table 1).2–6

Similar situations have been addressed in medical, bioethical, and legal publications regarding other forms of life-sustaining treatment, particularly mechanical ventilation and artificial nutrition and hydration. However, the ethical and clinical questions of futility in regard to ECMO treatment are unique. First, unlike the question of mechanical ventilation, which has reached the point of often being administered for an indefinite period of time, ECMO therapy may still be a sufficiently recent development to begin a discussion with both medical professionals and the lay public to understand the time-limited nature of such therapy. Second, because of the nature of ECMO therapy, the ethical questions are less about withholding of the treatment than withdrawal. Although legal and ethical consensus holds no formal distinction between these acts, the reality is that they often are perceived and approached differently.

The roles of intensive care unit (ICU) staff nurses, including critical care clinical nurse specialists, can be pivotal in representing nurses in these stressful, often emotional, situations. In addition, involvement of a clinical nurse specialist can protect and support nurses, resulting in a healthier workplace environment. Nurses of all levels continue to function as the primary point of contact and hence of information exchange between the

**Table 1** Extracorporeal membrane oxygenation: indications, complications, contraindications, and criteria for weaning

<table>
<thead>
<tr>
<th>Indications</th>
<th>Complications</th>
<th>Contraindications</th>
<th>Criteria for weaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute reversible heart or lung disease in patients likely to die³</td>
<td>Bleeding</td>
<td>Irreversible organ damage</td>
<td>Improvements in radiographic appearance</td>
</tr>
<tr>
<td>Resuscitation from acute cardiogenic shock</td>
<td>Thromboembolism</td>
<td>Multiorgan failure</td>
<td>Pulmonary compliance</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>Access difficulties (transfusion problems)</td>
<td>Patients who are not candidates for transplant</td>
<td>Arterial oxyhemoglobin saturation</td>
</tr>
<tr>
<td>Acute fulminant respiratory failure</td>
<td>Infection</td>
<td>Patients who cannot be anticoagulated⁵</td>
<td></td>
</tr>
<tr>
<td>Bridge to long-term mechanical support (eg, ventricular assist devices) and transplant</td>
<td>Cerebral hemorrhage⁶</td>
<td>Brain death</td>
<td></td>
</tr>
<tr>
<td>Severe respiratory failure⁶</td>
<td>Neurological devastation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Initial indications at the beginning of use of extracorporeal membrane oxygenation that have since been broadened.
² Not an absolute contraindication.
³ Higher risk when used during cardiac arrest.
⁴ Debated for use in adults.

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health care facility and patients and/or patients’ families. Not only is an understanding of the ethical issues involved here and the means to resolve or mitigate these problems important for all those involved, but nurses, in their role of information exchange, may be able to prevent overuse of this technology in cases of medical futility. Given nurses’ critical roles in ICUs, their contributions to developing new standards are indispensable. But to contribute in this way, an understanding of not just the clinical facts but the ethical issues is necessary. We first discuss the use of ECMO and the clinical circumstances that may lead to the decision to withdraw it. We then explore the concept of medical futility in relation to ECMO treatment and the difficult ethical issues that often result. Finally, based on the foregoing analysis, we offer suggestions for dealing with and mitigating the ethical problems that often arise in circumstances where ECMO may be withdrawn. These are suggestions that we hope will be useful for critical care departments in general and for nurses who face these conflicts with ECMO care, who can and should participate in developing standards for treatment and withdrawal.

**Background and Significance**

The function of ECMO is to remove venous blood from the patient, pass the blood through a membrane lung in which it is oxygenated and carbon dioxide is removed, and then return the blood to the patient. The use of ECMO began in the early 1970s “as a prolonged form of cardiopulmonary bypass to treat severe respiratory failure.”\(^\text{3(p2)}\)

Patients on ECMO life support are already at high risk for death, resulting in high potential for conflicts regarding continuation of treatment.

ECMO has since expanded as a therapy for a number of cardiopulmonary conditions. Indications for implementation of ECMO, complications of and contraindications for ECMO, and criteria for successful weaning from ECMO are summarized in Table 1.\(^\text{3-6}\)

Patients on ECMO life support are already at high risk for death, resulting in high potential for conflicts regarding continuation of treatment.\(^\text{4}\) Advances in medical technology, including ECMO, can cause a blurring of boundaries regarding defining medical futility in cases of respiratory and/or cardiovascular illnesses that are irreversible. The intent of providing ECMO life support (as opposed to the “function” of ECMO described earlier) is to provide intervention based on the pathophysiology of the affected organ with the reasonable expectation for heart and/or lung recovery. If recovery is hopeless and organ replacement candidacy is not an option because of severe brain injury, multiorgan system failure, and/or established unrecoverable heart and/or lung injury, removal of ECMO should be considered and presented to the appropriate decision maker.\(^\text{1}\) ECMO requires an interprofessional medical team of physicians, nurses, surgeons, respiratory therapists, ECMO specialists, and perfusionists who maintain a safe bedside 24 hours a day, 7 days a week. This interprofessional team must overcome feelings of stress, sense of failure, denial, personal bias, and guilt from multiple vectors. These vectors include perceived obligation to provide technology to save a life; actively turning off the ECMO circuit; potential legal ramifications, implications from social media; and potential “bad press” for the ECMO program, hospital, and health care providers involved in medically futile ECMO cases and the decision to stop ECMO life-support technology.\(^\text{7}\)

**Futility**

**Disputed Definitions**

On the surface, the concept of futility may seem clear and straightforward. That which is futile is that which does not work or does not fulfill the purpose for which it is intended. However, practical and concrete determinations of medical futility are far less clear and certain, admitting degrees of vagueness, ambiguity, and subjectivity.\(^\text{8-13}\) A brief review of the literature reveals a variety of definitions, conceptualizations, and taxonomies. Many scholars recognize the categories of physiological, quantitative, and qualitative futility.\(^\text{13-15}\) Physiological futility refers to the determination that an intervention will not achieve its intended purpose in a particular case.\(^\text{10,12,14}\) Quantitative futility means that the likelihood is low that a treatment will have the desired effect in a particular case.\(^\text{3,11,12,13}\) Qualitative futility means that the quality of benefit likely to be produced by the intervention is poor.\(^\text{3,10,12-15}\) Anderson-Shaw et al\(^\text{16}\) alternatively refer to descriptive and prescriptive futility. Bernat\(^\text{9}\) adds the categories of imminent demise futility and lethal condition futility. Mohindra\(^\text{13}\) refers to goal futility and value futility. This brief review only scratches the surface of the equivocal nature of the term and the variety of taxonomies available in the literature and thus hints of the difficulties involved in understanding and applying this concept.
Many of these categories fall along a distinction of focusing on objective, physical, or physiological standards (eg, physiological, quantitative, and descriptive futility), or focusing on more subjective, experiential, or value-based standards (eg, qualitative, prescriptive, and value futility). This division highlights the need to recognize both the clinical facts and realities but also the less concrete aspects of value and subjective experience. These clinical and value-based components of the concept can lead to good-faith disputes over the effectiveness or futility of a particular intervention in a particular case due to a reasonable variation of values among individuals.

Given the equivocal, uncertain, and variable nature of the concept of medical futility, it is not surprising that disputes and disagreements regarding it occur. Clinicians may judge an intervention with no reasonable likelihood of returning a patient to normal functioning or consciousness as a futile therapy that should be stopped, while the patient’s family may judge the fact that the intervention keeps the patient alive (even if only in a biological sense) as confirmation that the therapy is not futile. Not until these various perceptions and judgments are brought to the surface can a real discussion begin regarding the question of futility and removal of an intervention. The American Medical Association recommends that all institutions, regardless of size, adopt a policy on medical futility and define steps to consider regarding futile intervention and fair decision-making. Having a policy in place creates an honest and open atmosphere in which patients and surrogates can consider their own perceptions of futility in contrast to the policy of the facility. Of course all personnel in the ICU, including nursing staff, should be aware of such policies.

Responding to Cases Involving Potentially Futile Care

The steps to determine medical futility and the decision regarding when to stop ECMO technology include negotiation and case-specific clarification regarding understanding among the physician and the proxy for the patient receiving ECMO of what constitutes futile care.17 According to the American Medical Association, communication and evaluation of understanding medical futility include the following: joint decision-making, negotiation of disagreements, potential to escalate a consultation within institutional ethics committees for resolution, support for potential to transfer care to a different physician or transfer to an alternative institution to resolve conflicts regarding defining futile intervention with medical technology.16

The American Association of Critical-Care Nurses, in a joint policy statement with the American Thoracic Society, the American College of Chest Physicians, the European Society for Intensive Care Medicine, and the Society for Critical Care Medicine, echoes these recommendations with a resolution process including expert consultation, notice of the process to the surrogate, a second medical opinion, hospital committee review, opportunity for transfer to an alternative facility, and opportunity for extramural appeal.18 This process can involve any clinician in the ICU, but given their constant bedside presence, nurses, staff nurses, and advanced practical critical care clinical nurse specialists (hereafter designated as APNs) are most likely well placed to facilitate such communication and evaluation. It is important to emphasize that patients’ families should also be made aware that any decision to withhold or withdraw a particular intervention does not imply that all treatment and care is to be ceased. Not only may patients’ families not fully understand the function and limitations of a technology of ECMO and the ethical and clinical responsibilities and limitations of the health care facility, but physicians may not understand the goals, concerns, and fears of patients’ families and may not accurately assess their comprehension of the clinical and ethical issues involved. Both staff nurses and APNs are well placed to facilitate greater understanding on both sides.

The Ethics of Withdrawal of Technologic Supports

Withdrawal of ECMO technology raises a number of complex ethical issues (Table 2). The ethics of withdrawal of ECMO follows closely the ethics of removal of life-sustaining therapies in general, a topic on which much has been written in the past several decades, although much less has been written about ECMO in particular. A clear understanding of these various issues can aid staff nurses, APNs, and other clinicians in the ICU in navigating difficult situations that may lead to great conflict and inappropriate actions.
Central to the ethical provision of any medical intervention is the principle of respect for autonomy, as the ethical foundation for the doctrine of informed consent. Autonomy refers to an individual’s rational capacity for self-determination.\(^{19,20}\) To ignore or willfully deny a person’s decisions for his or her own being constitutes a reduction of who he or she is as a person, to reduce him or her to something less than a person, even when done for what is perceived as the person’s own good. Thus, according to the principle of respect for autonomy, clinicians have a duty to respect the wishes of patients regarding autonomously chosen medical interventions. This respect would imply also the right of a patient to refuse a treatment.

When a patient lacks decision-making capacity, a surrogate decision maker is used to make the decision that the patient would if she or he could. Because of the often sedated state of patients receiving ECMO, the use of surrogate decision makers in such cases is common. A form of advance directive may also be in place to better ensure that the wishes of the patient are known and followed. Conflicts arise when care providers and patients’ surrogates do not agree, when one side believes, for example, that withdrawal of life-sustaining care is appropriate but the other does not. In such cases, the nurse, whether APN or staff nurse, can serve an important ethical role in clarifying misunderstandings on both sides.

### Medical/Professional Autonomy and Standard of Care

The exercise of patients’ autonomy, however, has limits.\(^{5,21,22}\) Just as the patient’s autonomy should be respected, so should a clinician’s professional autonomy to practice within accepted standards of care. Ethically, standards of care recognize not only the importance of patients’ autonomy but the principles of nonmaleficence and beneficence as well. In this context, complications can arise as the identification of goods and harms admits some degree of interpretation and a preconceived value system. For example, death is typically perceived as a harm. However, in the ICU, it is not uncommon to perceive the state of some patients such that continued life through technologic means is a harm. In a recent article,\(^{23}\) philosopher Ben Bradley argues that death is not an intrinsic harm but a relative or contrastive harm, meaning that the circumstances surrounding a death are fundamentally relevant to a reasonable determination of the death as a bad or good occurrence. The sudden death of an otherwise healthy young man would clearly be bad, whereas the death of a long-suffering

### Table 2 Ethical issues in withdrawing technologic support

<table>
<thead>
<tr>
<th>Moral principle or concept</th>
<th>Moral issues and complicating factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients’ autonomy</td>
<td>Lack of capacity, need for surrogate decision-making</td>
</tr>
<tr>
<td>Medical autonomy, standard of care</td>
<td>Negative duty to refrain from harming vs positive duties to prevent and remove harm and to promote the welfare of patients</td>
</tr>
<tr>
<td>Futility</td>
<td>Competing definitions of futility, both among medical professionals and between patients’ families and healthcare professionals</td>
</tr>
<tr>
<td>Moral distress</td>
<td>Lack of power or authority to do what is perceived as right</td>
</tr>
<tr>
<td>Resource allocation</td>
<td>Fairness of treatment</td>
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</tbody>
</table>

**Patient Autonomy and Professional Autonomy**

**Patient Autonomy/Surrogacy.** Central to the ethical provision of any medical intervention is the principle of respect for autonomy, as the ethical foundation for the doctrine of informed consent. Autonomy refers to an individual’s rational capacity for self-determination.\(^{19,20}\) To ignore or willfully deny a person’s decisions for his or her own being constitutes a reduction of who he or she is as a person, to reduce him or her to something less than a person, even when done for what is perceived as the person’s own good. Thus, according to the principle of respect for autonomy, clinicians have a duty to respect the wishes of patients regarding autonomously chosen medical interventions. This respect would imply also the right of a patient to refuse a treatment.

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patient facing imminent death may in fact be perceived or judged as good in contrast to the alternative of continued suffering and loss of quality of life.

When a staff nurse or APN involved in the care of a patient receiving ECMO judges that the harm of the care outweighs the possible benefit, or that the death of the patient is less a harm in contrast to the prolongation of life through technologic means, an ethical conflict can ensue between the nurse and the physician, surrogate, or others who perceive the situation differently. Such conflict can result in friction among the disputing parties or anxiety within the nurse (moral distress) if the nurse feels unable to voice his or her concerns or effect change. Ideally, of course, such conflict would lead to further communication between parties (facilitated by nurses, ethics consultants/committee, chaplaincy, or other institutional resources), resulting in a possible resolution.

**Withholding Versus Withdrawing Life-Sustaining Treatment**

The principle of patients’ autonomy prohibits the implementation of interventions that a patient or surrogate has not consented to, and professional autonomy permits clinicians to refuse to provide interventions believed to be medically or ethically inappropriate, so the question of the distinction between withholding and withdrawing life-sustaining treatment is worth noting. For many other forms of life-support technologies (eg, mechanical ventilation, artificial nutrition, and hydration), questions of both withholding and withdrawing treatment are relevant. Given the nature of ECMO technology, withholding is a less relevant concern. As noted earlier, a clinician is not ethically required to provide a treatment that he or she reasonably perceives as not medically or ethically appropriate. Thus, withholding a treatment, even contrary to the wishes of a patient or surrogate, is widely perceived as ethically justified. However, the ethics of withdrawal of existing treatment can seem different because it involves an action (removing already functioning technology), as opposed to a refusal to act. Indeed, as noted by Curtis and Burt,

Decisions about withdrawing interventions that clinicians have previously viewed as potentially beneficial often have a different and more powerful impact on patients and families than decisions not to initiate therapies in the first place.24(p750)

Further, a significant number of clinicians also may perceive these acts differently.25 However, it is widely accepted among medical ethicists that there is no ethical distinction between withholding and withdrawing life-sustaining treatment.24,26-28 Despite this broad ethical consensus among ethicists and medical associations, the disparate effects that withdrawal versus withholding of life-sustaining treatment can have on both patients’ families and clinicians need to be taken seriously, particularly regarding the question of unilateral withdrawal.

**Legal Consent and Authority**

A variety of laws and legal precedents exist that determine the legal limits of clinicians’ actions with regard to withholding and withdrawing life-sustaining technology. As with the bulk of ethical discourse regarding these issues, the legal case precedents are primarily cases involving life-sustaining therapy other than ECMO, particularly mechanical ventilation and artificial nutrition and hydration. Since the Cruzan case, the legal right of surrogates, based on the liberty interest of the 14th amendment to the US Constitution, to decide to withdraw life-sustaining treatment has been recognized across the United States.30 More relevant to the matter at hand, however, is the case of Helga Wanglie, an 86-year-old woman in a vegetative state receiving mechanical ventilation.31,32 Physicians believed discontinuation of mechanical ventilation was medically and ethically appropriate, whereas the patient’s surrogate (spouse) disagreed. The court ruled in favor of the spouse, Mr Wanglie, remaining his wife’s proxy. More recently, a similar case involving a 61-year-old man in a minimally conscious state, Hassan Rasouli, was decided by the Supreme Court of Canada with a similar result, reinforcing the legal right of patients’ surrogates to decide when to remove life-sustaining care in Canada.33

In both the Wanglie case and the Rasouli case, health care providers came to the conclusion that life-sustaining treatment was no longer beneficial and would only result in decompensation of organ systems and deterioration of the body. In both cases, the patient’s surrogate (the spouse of the patients) disagreed and believed that any continuation of life provided by life-sustaining treatment...
is beneficial according to their religious viewpoints (one Christian and one Muslim). The Wanglie and the Rasouli cases indicate that a legal difference between withholding and withdrawing life-sustaining treatment is often recognized regarding the question of unilateral withdrawal against a surrogate’s wishes, despite the US Supreme Court’s ruling that there is no legal distinction between withholding and withdrawing life-sustaining treatment. In cases of unilateral withdrawal on the provider’s side, the decision-making authority of the surrogate tends to hold more weight. At the state level, a great deal of variability exists regarding the laws of withdrawing life-sustaining therapy. So, an understanding of specific state laws is important for any professional working in an ICU who may face these issues.

As occurred in the case of Helga Wanglie, if the surrogate disagrees with the decision to withdraw life-sustaining treatment, another facility willing to continue such treatment may be sought. This resolution generally is both ethically and legally acceptable. But also as in the case of Helga Wanglie, if no such willing facility can be found, providers may be ethically justified in discontinuing life-sustaining treatment. However, the legality of such an act may not be as clear. Regardless of the laws of any particular state or jurisdiction, we are of the opinion that unilateral withdrawal against a surrogate’s consent and appeals to courts for resolution, at the very least, are not ideal. Every possibility of reaching consensus between interested parties should be exhausted.

Resource Allocation

For patients whose conditions are irreversible and who are on a clear path of decline, the continued allocation of resources to keep these patients alive can seem wasteful. The resources, it seems, could be better (more justly) allocated toward patients more likely to recover or improve. Further, “We could not afford,” writes ethicist Steven Miles,

A universal health care system based on patients’ demands. Such a system would irrationally allocate health care to socially powerful people with strong preferences for immediate treatment to the disadvantage of those with less power or less immediate needs.

The cost of care perceived as futile may then set patients or patients’ families against taxpayers and payers of insurance premiums, positioning clinicians as “‘stewards’ of limited funds when the wishes of patients are pitted against those of society.”

What a just allocation of resources in health care would be is not an easy question to answer, and it most likely does not admit a singular answer across all modes of health care provision. Uncertainty and dispute over a proper understanding of distributive justice result from the inability to determine an objectively correct material principle (utilitarian, egalitarian, communitarian, or libertarian) of justice. Despite such uncertainty and dispute, attention to the concept of justice provides a basis for addressing conflicts and disagreements along these lines and for reaching resolutions. Recognition and conceptualization of justice in general and distributive justice in particular provides a frame for nurses and other clinicians to express concerns of the waste of resources and to further the ethical discussion regarding any particular case. In their discussion of distributive justice in health care, Beauchamp and Childress introduce the fair opportunity rule as a standard consistent with all material principles of justice. According to this rule, one should not receive or be denied social benefits because of natural or social qualities for which one is not directly responsible. The unfair advantage of socially powerful people that Miles referred to would be addressed by this rule. Beauchamp and Childress also refer to a decent minimum standard of health care that would cut across all material principles of justice. If some patients are being denied this decent minimum because of the continued, possibly futile, treatment of some patients receiving ECMO, this basic standard of justice would not be met.

Moral Distress

Prolonging death with the use of ECMO technology, when for whatever reason (usually a lack of consent) ECMO cannot be withdrawn despite the perception of (some) clinical staff that withdrawal is the appropriate next step, causes moral distress for health care providers. At the heart of moral distress is a sense of powerlessness. Because of internal or external factors, an individual is unable to act in the manner he or she understands to be morally appropriate or obligatory. Although moral distress can be found among individuals within all fields of health care, it was first and is still commonly associated with nurses, possibly because of the hierarchical nature of the health care environment. It is important to
keep in mind that moral distress is not merely emotional distress and is not defined simply by the emotions of anxiety, fear, or sadness that may be associated with it. Rather, moral distress is specifically characterized by a situation that involves a moral wrong or perceived moral wrong and the inability to act in the perceived morally correct manner.36

In a review of studies concerning moral distress and end-of-life care, Browning finds the delivery of care that is perceived to be medically futile to be “the most common phenomenon . . . causing moral distress in critical care nurses.”37(p144) Her study focused on ventilator support as a form of possibly futile treatment causing moral distress. But such findings can clearly be extended to the provision of ECMO as well. In both instances, the perception is of a patient failing to thrive, unable to benefit from the treatment, and possibly enduring suffering. In a study of staff nurses in a medical ICU, Elpern et al found “moderate levels of moral distress overall” but that “high levels (intensity and frequency) occurred when nurses felt they were providing aggressive care to patients who would not benefit.”38(p528) It is not merely the witnessing of the suffering or lack of benefit that causes the anxiety and sadness, but the recognition that this state is morally problematic and feeling that one is not in a position to effect change.

Moral distress, over time, can lead to job dissatisfaction, burnout, loss of nurses from the profession, and even aversion to participation in blood and organ donation.38-40 This last item is the result of witnessing the waste of resources on treatment judged to be futile.38 Such distress, and the consequences associated with it, may be mitigated by providing clinicians in the ICU, including staff nurses and APNs, the resources to act on their beliefs and concerns. These resources would include an understanding of the ethical and legal issues involved to better conceptualize their own feelings and reactions and the ability and opportunity to give voice to these. In addition, awareness of institutional resources such as palliative care consultations, ethics consultations, or an ethics committee may provide nurses with the ability and opportunity to express their concerns with institutional support. Any particular instance of moral distress may or may not be based on a justifiable moral judgment, but the mere ability to voice these concerns can mitigate the power disparities that cause moral distress.

**Suggestions for Change**

More work must be done to create guidelines for stopping ECMO life support. Attention to the underlying ethical issues involved in withdrawing ECMO support and to the concerns and distress of all involved can go a long way in mitigating the multitude of problems that arise. We hope that the following suggestions will be helpful for staff nurses and APNs in the critical care setting who would like to improve this area of treatment and reduce the incidence of moral distress as they contribute to the process of policy change (Table 3).

Ethics committee consultations can yield recommendations and clarify explanations that support medical decisions among patients’ family members and members of the ECMO health care team, with the primary determinant of care concerning best interest and deterring unwarranted legal action.16 The communicative and informational role of the nurses involved in ECMO care can be pivotal here. APNs can contribute during ethical discussions with the health care team to determine when the lifesaving benefits of ECMO are causing harm to the morale of the ECMO health care team and the specific families. With clear understanding of the ethical issues involved in removal of life-supporting technology like ECMO and a recognition of the particular nursing role of patient advocate, both APNs and staff nurses in the ICU can help to alleviate or mitigate many of the ethical problems that arise when withdrawal is considered or perhaps should be considered. The critical care APN, in particular, may be well positioned to implement institutional change with the ultimate goal to protect the psyche of the nurses and ECMO health care team involved with stopping ECMO life-support technology. The APN can facilitate and organize debriefing sessions for the involved parties that allow health care providers to share and discuss feelings of guilt, stress, and fear related to how the decision of medical futility and stopping ECMO life support was made. Discussions about perceived emotional burdens at the bedside allow nurses to have a voice, cope, share feelings and opinions, and feel supported by coworkers, leadership, and management. Managing
emotions and developing coping strategies support a healthy work environment by validating nurses’ perceptions of stress and anxiety after stopping ECMO life-support technology. Nursing participation, especially nurses with sufficient education and training in ethics, can enhance the scope of interprofessional input and disciplinary contribution to case discussions at institutional ethics committee meetings. Participation of nurses is critical to inclusively represent and clarify the nursing perspective during ethical discussions related to ECMO care. Critical care APNs may represent the nursing voice at the ethics committee table when institutional futility guidelines are defined regarding stopping ECMO life-support technology. Toward this end, further ethics training for nurses at all levels would be encouraged. This training could be in general clinical ethics or it could be more specific education in ethics consultation or ethics mediation.

Clarification of “stopping rules” exists for ethically fraught areas like clinical research and chemotherapy but such rules are unclear relative to discontinuing ECMO. For most of these other areas, universal stopping rules may not exist across the discipline, and effective stopping rules may need to be flexible and context-dependent, but in general, the use of stopping rules is common and recognized. In this way, the concept exists in the clinical and academic discourse, allowing potential emendation of stopping rules and consensual standards. Also, the very existence of these rules, with a conscientious application of them and clinical or academic reflection upon them, provides for protection of patients or study participants from harmful or possibly futile treatment. Stopping rules for chemotherapy are important in regard to concerns over the use of “health care resources for ever-decreasing individual patient benefit.” APNs involved in creating “ECMO stopping guidelines” will consider the specifics surrounding unique ECMO cases and represent nursing when collaborating with the multidisciplinary health care team and institutional leaders. Critical care nurses at large can also become part of the research team and assist with research and data collection regarding developing policies that determine ECMO discontinuation criteria. The decision to allow death by stopping ECMO life support is an emotional burden for all team members, and clarifying ECMO stopping guidelines is a beginning in the attempt to minimize this emotional burden by clinically determining when ECMO has become a futile intervention preventing death and causing only ongoing harm.

**Conclusion**

When the therapy provided by ECMO becomes perceived as futile, a variety of ethical problems arise, including questions of autonomy and proper decision-making.
authority, the determination of harm versus good provided by the treatment, the difficult and uncertain concept of medical futility, issues of social justice related to the possible waste of medical resources, and moral distress on the part of those providing perceived futile care. Clarifying ECMO stopping guidelines will help mitigate many of these problems and minimize moral distress among those involved in withdrawal of ECMO life-support technology. The critical care nurse, in particular, can participate in research data collection and contribute to ethical discussions regarding determining when ECMO life-support technology is no longer beneficial to improve the patient’s condition. The critical care APN has the responsibility to protect the psyche of frontline staff, and management has the responsibility of recognizing and supporting the numerous multidisciplinary ECMO health care providers during this difficult and emotional process of providing end-of-life care after stopping ECMO life-support technology. CCN

References

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A patient asked me “Are you a good witch or a bad witch?” I first questioned whether he might be confused and then regretted my decision to wear a pointed black hat to work that Halloween. I replied “I’m not a witch, I’m a nurse and you are in the hospital . . . remember?” He stated “I’m not confused, I know you are a nurse but you are also a witch!” I gave him an inquisitive look, and he said, “I’ve seen you flying around performing magic, delivering potions in chalices, talking to machines, and just this morning you recited incantations to my foot when you could not locate the pulse and then found it. You are a witch.” I smiled and said “I prefer nurse, but if given the choice between good witch and bad witch, I choose good witch. And by the way, I’m even certified for my critical care magical skills.” We both smiled.

**Adult CCRN Practice Questions**

1. A patient with sickle cell anemia is cool to touch, has icteric sclera, tachycardia, and a hemoglobin level of 8 g/dL. This presentation and anemia are most likely related to

   A. A deficiency of iron
   B. A nutritional disorder
   C. A hemolytic process
   D. An autoimmune disorder

   Test plan topic: Heme is part of Gastrointestinal (GI), Renal, Heme/Immune, Endocrine, and Integumentary, which are 20% of the CCRN questions

2. To decrease the risk for a vasovagal response when removing a femoral sheath, the nurse should

   A. Administer intravenous (IV) pain medicine
   B. Administer atropine 1.0 mg IV prophylactically
   C. Ask the patient to bear down with sheath removal
   D. Elevate the head of the bed 45°

   Test plan topic: Cardiovascular, 18% of the CCRN questions

3. A patient with sepsis is started on an insulin infusion due to hyperglycemia. The nurse resident asks the preceptor why a patient who does not have diabetes requires an insulin infusion and at such a high dose. The best response by the critical care nurse would be

   A. “Critical illness decreases resistance to insulin.”
   B. “Hyperglycemia in the critically ill is a normal response.”

   Contributed by Carol Rauen, RN-BC, MS, CCRN, PCCN, CEN, the department editor, is an independent clinical nurse specialist in The Outer Banks of North Carolina and a staff nurse in the burn trauma intensive care unit at Sentara Norfolk General Hospital in Virginia. She wrote CCRN question 5. Carol welcomes feedback from readers and practice questions from potential contributors at rauen.carol104@gmail.com.

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C. “In critical illness, insulin is better absorbed subcutaneously.”
D. “Severe insulin resistance requires higher insulin doses.”

Test plan topic: Endocrine is part of GI, Renal, Heme/Immune, Endocrine, and Integumentary, which are 20% of the CCRN questions

4. **To decrease the risk of rebleeding in a patient admitted with upper gastrointestinal bleeding from portal hypertension and esophageal varices, the nurse would anticipate administering a**
   A. Proton pump inhibitor
   B. Somatostatin analogue
   C. Histamine receptor antagonist
   D. Nonselective β-adrenergic blocker

Test plan topic: GI is part of GI, Renal, Heme/Immune, Endocrine, and Integumentary, which are 20% of the CCRN questions

5. A patient is transferred to the intensive care unit (ICU) emergently from a medical care area with uncontrolled bleeding. Assessment reveals that the patient takes Xarelto (rivaroxaban). In addition to packed red blood cells (RBCs), the team should anticipate the need for
   A. Protamine sulfate
   B. Fresh frozen plasma
   C. Vitamin K
   D. Cryoprecipitate

Test plan topic: Heme is part of GI, Renal, Heme/Immune, Endocrine, and Integumentary, which are 20% of the CCRN questions

**Correct Answers and Rationales for CCRN Practice Questions**

1. **Correct Answer: C**

   **Rationale**
   Sickle cell anemia is an inherited disease resulting in RBC malformation, or sickling, under stress-related conditions. The sickled cells inhibit blood flow, damage vessel endothelium, and activate the coagulation cascade, leading to increased RBC destruction (jaundice) and hemolytic anemia. The mean life span of RBCs in a person with sickle cell disease is 60 to 90 days compared with a normal life span of 120 days. Anemia may be due to numerous factors related to decreased RBC production, increased RBC destruction (C), acute or chronic RBC loss (D), or nutritional deficiencies (B) such as iron (A), folic acid, or vitamin B₁₂.

   **Source**

2. **Correct Answer: A**

   **Rationale**
   To decrease risk for a vasovagal reaction and reduce discomfort and breath holding associated with sheath removal, premedication for pain is recommended. Patients should be instructed to breathe normally and not hold their breath. Bearing down (C) can trigger a vasovagal response. Atropine (B) should not be administered for prophylaxis. Because of the risk of bleeding or vessel injury after stent placement, patients with an indwelling sheath should not have the head of the bed elevated (D) unless signs of pulmonary edema or respiratory distress occur. The head of the bed should be flat with gradual elevation not to exceed 30º.

   **Source**

3. **Correct Answer: D**

   **Rationale**
   Hyperglycemia often occurs during times of critical illness and is associated with worse clinical outcomes. Increased insulin dosing is associated with increased insulin resistance or increased stress response, especially in patients with sepsis. Increased doses of insulin (A) are associated with increased cellular resistance to insulin. As a response to illness, injury, or inflammation, increased amounts of counterregulatory hormones are released, resulting in increased serum levels of glucose. Because of inconsistent tissue perfusion, insulin is better absorbed and used when administered IV (C). The metabolic response to critical illness may be natural and protective in some facets; however, the body’s inability to use the excess is detrimental (B).

   **Source**
4. Correct Answer: D
Rationale
In the treatment of esophageal varices, the recommendation for primary prophylaxis and to lower portal venous pressure is a nonselective β-blocker. β-Blockade is generally more effective in lowering portal pressure, thereby reducing portal hypertension pressure and lowering risk for rehemorrhage and mortality. Octreotide and somatostatin (B) are able to limit or decrease splanchnic blood flow through vasodilatation, thereby reducing portal pressure, but are not as effective against rebleeding. Proton pump inhibitors (A) and histamine receptor antagonists (C) do not influence portal pressure.

Sources

5. Correct Answer: B
Rationale
Rivaroxaban is an indirect Xa inhibitor and anticoagulant prescribed for clot prevention for patients with nonvalvular atrial fibrillation. There is no reversal agent for this drug. Standard methods for bleeding control should be used when a patient taking this agent has critical bleeding such as direct pressure, blood product administration, and surgical control. Protamine sulfate (A) is a reversal agent for unfractionated heparin, vitamin K (C) is used with warfarin, and cryoprecipitate (D), a human blood product, might be given but not before packed RBCs, platelets, or fresh frozen plasma.

Source

Cardiac Medicine Certification (CMC) Practice Questions
1. ST-segment abnormality is present on the 12-lead electrocardiogram (ECG) of a patient complaining of new-onset chest pain. ST-segment changes from pericarditis would be evidenced as
A. Diffuse ST-segment elevation with concave-upward ST segments
B. Diffuse ST-segment elevation with convex-upward ST segments
C. Diffuse ST-segment depression with concave-upward ST segments
D. Diffuse ST-segment depression with convex-upward ST segments

2. Assessment findings that would be consistent with venous peripheral vascular disease include
A. Shiny skin with no hair, pale cool extremities, pain with ambulation
B. Normal color, severe pain, open sore at the end of the great toe on the right foot
C. Edema 2+, absent pulses, feet become cyanotic when dependent
D. Brown pigmentation on ankles, warm legs, left lateral malleolus open area

3. A patient with stage C heart failure and pneumonia has a cardiac output of 1.9 L/min, pulmonary artery systolic pressure (PAS) of 42 mm Hg, hemoglobin (Hgb) level of 8.2 g/dL, pH of 7.43, and an oxygen saturation (SaO2) of 85%. What interventions would improve the patient’s oxygen delivery?
A. Decrease the cardiac output with a negative inotropic agent
B. Increase the Hgb level with packed RBCs
C. Increase the pH with IV sodium bicarbonate
D. Decrease the PAS with a bronchodilator

4. The best assessment strategy to evaluate systemic vascular resistance (SVR) in a patient who does not have a pulmonary artery catheter would be
A. Heart rate (HR) and respiratory rate (RR)
B. Capillary refill
C. Diastolic blood pressure
D. Systolic blood pressure

5. A patient stops talking in the middle of a sentence, the patient’s eyes close, and the monitor shows the following rhythm called
A. Sick sinus syndrome
B. Second degree atroventricular (AV) block, type II
C. Acute coronary syndrome with right bundle branch block
D. Complete AV block

**Correct Answers and Rationales for CMC Practice Questions**

1. **Correct Answer: A**
   **Rationale**
   Diffuse ST-T wave changes occur as a result of inflammation of the myocardium beneath the inflamed pericardium in pericarditis. A concave pattern is common as a result of inflammation as opposed to the convex pattern (B), which typically occurs with myocardial injury due to coronary artery occlusion, or ST-segment depression (C, D) which commonly occurs with ischemia.

   **Source**

2. **Correct Answer: D**
   **Rationale**
   Venous peripheral vascular disease typically manifests as distal edema, warm skin, brown pigmentation from iron deposits leaking from the venous status staining the skin, resting pain, and venous ulcers. Peripheral artery disease is manifested by pain with ambulation (A), severe pain (B), distal/digit ulcers (B), and absent pulses (C).

   **Source**

3. **Correct Answer: B**
   **Rationale**
   A patient with a low hemoglobin level, stage C heart failure (symptomatic structural heart disease), and pneumonia would have poor oxygen delivery as evidenced by the \( \text{Sao}_2 \) of 85%. Increasing the amount of hemoglobin available to carry oxygen could improve delivery. Decreasing contractility (A), shifting the oxyhemoglobin curve to the left (C), would decrease oxygen delivery. Bronchodilatation might decrease the PAS (D), but without increasing left ventricular stroke volume, it would not increase oxygen delivery to the cells.

   **Source**

4. **Correct Answer: C**
   **Rationale**
   The SVR can be calculated with this formula: \( \frac{(\text{MAP-RAP}) \times 80}{\text{CO}} \), where MAP is mean arterial pressure, RAP is right atrial pressure, and CO is cardiac output. (SVR normal, 900-1400 dynes sec\(^{-1}\) cm\(^{-5}\)). In the absence of these measurements, the diastolic blood pressure (C) reflects the mean pressure of the systemic vessels between the left ventricle and the right atrium. The systolic blood pressure (D) is the peak pressure with left ventricular (LV) contraction, the HR and RR (A) are not pressures, and capillary refill (B) reflects perfusion.

   **Source**

5. **Correct Answer: D**
   **Rationale**
   A complete AV block (D) or third-degree heart block manifests as consistent P-P and R-R intervals that are electrically independent of each other. There is no consistency to the PR interval, and the QRS interval is typically wide. In sick sinus syndrome (A) the P-P interval is irregular and often has long pauses but AV conduction is normal. A second-degree AV block type II (B) has constant PR intervals and intermittent blocked P waves, and a right bundle branch block pattern (C) shows an rsR' pattern in V\(_1\) and a qRs pattern in V\(_6\).

   **Source**

AACN Certcorp publishes a study bibliography that identifies the sources from which items are validated. The document may be found in the AACN Certification exam handbook. The contributor of each question written for this column has listed the source used in developing each item. CCN
Ask the Experts

Scope of Practice

Q

How do I know if an activity is within my scope of practice? Our physicians have asked us to begin inserting tissue plasminogen activator into chest tubes, and we are wondering if that is within our scope of practice.

A

Carol Hartigan, RN, MA, BSN, replies:

The answer to this question may be different if the practitioner is a registered nurse (RN) or an advanced practice RN (APRN), depending on the specific activity in question. However, the primary authority for determination of the correct answer to the question will always be the same: the board of nursing (BON) in the state in which you are practicing. If you hold multistate licensure, the governing state is the state in which the patient you are caring for is located. When practicing lawfully under the Nurse Licensure Compact, the nurse is required to be licensed or to have the privilege to practice in the state where the patient is physically located. This includes situations in which the nurse is actually delivering care at the bedside, directing the patient’s care, or providing care virtually such as in the practice of the CCRN-E. If a nurse is practicing under the Nurse Licensure Compact in a remote state, the nurse is accountable for complying with the scope of practice as outlined in the nurse practice act (NPA) in the remote state.¹

The scope of practice of a licensed health care profession is defined in each state’s statutes or laws in the form of a practice act, with rare exception. It is the state legislature that has the authority to adopt and/or modify practice acts, which modify the practice of a profession. State practice acts are intentionally written broadly so that they will not require frequent change through the legislative process. The fine-tuning of the law takes place in the administrative rules or regulations, which are usually authorized through the NPA to be promulgated by the BON with public input. We are seeing this happen currently in many states, as BONs are implementing the Consensus Model for APRN Regulation. Boards are updating their practice acts and/or rules to more clearly state who is an APRN, to define the scope and standard of practice for these categories of practitioners, and to delineate the educational and certification requirements to qualify for these designations.

At the same time, some BONs are also clarifying these areas related to their RN and licensed practical nurse categories in the areas of education, scope of practice, delegation, continuing competence, and discipline. It is a good time to review your state’s NPA to see if there is anything that has been changed or updated. Some BONs publish periodic newsletters that are available on their websites and contain information about changes to their statutes. Whenever a BON makes a change to rules and regulations, public hearing notices must be posted. You can find links to all BON websites here: https://www.ncsbn.org/contact-bon.htm.

When reviewing your NPA and BON rules, you will not find a “laundry list” of tasks that may be performed by each level of practitioner; if the law and regulations were written in this...
manner, they would quickly become outdated. Instead, the statutory language is written broadly and the rules are written as guidelines for implementation of the statute. Some BONs issue advisory opinions or declaratory rulings in response to specific practice questions from the public, but others do not, believing that these types of rulings tend to limit practice. Instead, many of the BONs have developed decision models or decision trees related to scope-of-practice questions. The Arizona, Georgia, Maine, Nevada, North Carolina, Oklahoma, Oregon, Rhode Island, Texas, Washington, and Wyoming BONs have developed scope-of-practice decision trees to assist RN licensees in scope-of-practice decisions. The BONs in Iowa, Kentucky, Nebraska, Ohio, and Vermont are among those that have developed APRN-specific decision models.

These decision models have minor variations, but they all pose the following key questions to the nurse, after suggesting that first the task in question be clearly identified and clarified.

1. Is this activity/role/task/procedure/intervention prohibited by your state’s NPA, rules, declaratory rulings or other applicable law, or accreditation policy?

2. Does the activity/role/task/procedure/intervention meet criteria such as:

   - congruent with national nursing standards,
   - consistent with current evidence-based practice,
   - consistent with policies and procedures approved by the employing facility,
   - appears in the nursing literature and research, and
   - conforms to the practice of a “reasonable and prudent nurse in this situation or environment”

3. Do you possess the requisite knowledge, clinical skills, abilities, and judgments to safely and effectively perform this activity/role/task/procedure/intervention based on your prelicensure educational program, postgraduate program, or continuing education program? Is this education documented?

4. Are you prepared to accept accountability for the outcome of the activity/role/task/procedure/intervention and are you competent to provide emergency care for the patient in the event of untoward outcomes due to the activity/role/task/procedure/intervention?

   If you are an APRN, the questions are similar, but questioning regarding educational preparation is focused on the role and population. Although RNs are educated as generalists and are prepared to care for patients across the lifespan and at various degrees of acuity, APRN scope of practice is by necessity more narrow because of the high degree of accountability for patient safety that accompanies their expanded role. For example, as quoted below, some of the questions that the Kentucky BON\(^2\) recommends the APRN ask include the following:

   Is the act/task/procedure consistent with my graduate education, current national educational accreditation standards, current nursing scope and standards, current certification examination blueprint/outline/role delineation study, current evidence-based nursing literature, my institution’s policies and procedures, the institution’s accreditation standards?

Advanced Educational Preparation—The APRN must determine whether his/her program of study gave the APRN a knowledge base upon which to accomplish the action.

- Did I complete a post-basic, accredited educational program that prepared me to diagnose and manage the care of patients in this population (family, adult-gerontology, neonatology, pediatric, psychiatric/mental health, women’s health) of patients?

- Did the curriculum for my population-focused advanced practice educational program provide the basic background knowledge for the APRN to develop new skills to perform this act in a safe and effective manner?

- Did my post-basic accredited educational program prepare me to practice primary care or acute care with the population of patients for which I am planning to diagnose and manage care?

- Did my post-basic accredited educational program include supervised clinical and didactic training focusing on this population?

- How did I acquire the additional knowledge and skill to perform the act?

Certification Based on Professional Scope and Standards—Next, the APRN must determine whether the action is consistent with the scope and standards set by the national certifying organization that certifies the APRN. Generally, these scope and standard statements are written in broad language and will probably support most actions. However, there may be exceptions.

- Do professional nursing standards support or validate what I am doing?
• Is additional certification required to do this skill on an ongoing or specialized basis?²

The National Organization of Nurse Practitioner Faculties (NONPF) has developed 2 statements to clarify the scope of practice of acute and primary care nurse practitioners. The first statement³ provides the nurse practitioner educator perspective on the distinctions of acute care and primary care nurse practitioner practice. The second statement⁴ was developed through a national consensus process involving multiple stakeholders. The purpose of this statement was to assist stakeholders such as employers and other contractors in appropriate hiring decisions. These statements³,⁴ are available on the NONPF website.

One of the most common misconceptions that we encounter at the American Association of Critical-Care Nurses is with RNs who have always practiced in acute/critical care but obtain graduate education as an NP in a primary care area such as Adult NP or Family NP. Many times, they have been incorrectly counseled that it will be allowable for them to practice as an NP caring for acutely/critically ill patients because they have acute/critical care experience as an RN. However, these 2 completely different scopes of practice, and RN experience is not a satisfactory substitute for the NP didactic knowledge and clinical competencies that are acquired in the graduate program, nor would these competencies have been validated through the national certification examination for that role. It would be unlikely that a malpractice insurer would stand behind a primary care APRN practicing as an Acute Care APRN.

The decision tools that have been developed by the BONs are useful tools, but the best advice can be obtained from the practice specialist at your state BON. Remember that your employer has the right to limit or restrict your practice but does not have the authority to expand it. You worked so hard for your nursing license; do not let scope-of-practice issues cause you to put it in jeopardy. CCN

References

Ask the Experts
Do you have a clinical, practical, or legal question you’d like to have answered? Send it to us and we’ll pass it on to our Ask the Experts panel. Questions may be mailed to Ask the Experts, Critical Care Nurse, 101 Columbia, Aliso Viejo, CA 92656; or sent by e-mail to ccn@aacn.org. Questions of the greatest general interest will be answered in this department each and every issue.
Delirious patients are common in intensive care units (ICUs). Delirium occurs in 20% to 50% of nonintubated ICU patients and 60% to 85% of ICU patients who are receiving mechanical ventilation. Delirium is associated with increased mortality, increased hospital stay and cost of care, and long-term deterioration of cognitive and functional processes. Delirium is a multifactorial syndrome that is missed by critical care nurses and clinicians approximately 72% of the time when a nurse is completing a general bedside assessment. Positive outcomes for patients can be achieved through the use of evidence-based assessment tools to help better detect and manage delirium.

Project Identification
The ICU at Fox Chase Cancer Center (FCCC) is an 8-bed unit that provides care to medical and surgical oncology patients. The patients at FCCC are at high risk for ICU delirium because of the chronicity of their illness and the possible cancer disease processes, which include brain metastasis, speech and hearing deficits, and increased use of narcotics and benzodiazepines. In 2013, 60% of our patients were more than 65 years old; the older population, in conjunction with frequent use of anesthetic agents from surgery, led to an increased prevalence of delirium. A team of 4 nurses participating in the American Association of Critical-Care Nurses (AACN) Clinical Scene Investigator (CSI) Academy were empowered to adopt best-practice interventions in the identification and nonpharmacological management of delirious patients.

Purpose and Goal of the Project
No practice for assessing and managing delirious patients had been established at FCCC before this CSI project. A literature review was conducted, and the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) was chosen as the assessment tool for its reliability and validity as well as ease of use for clinical staff (Figure 1). The ABCDE bundle was adopted for the nonpharmacological management of delirious patients. This bundle stands for awakening, breathing trial for patients receiving mechanical ventilation, choice of sedation, delirium detection, and exercise (Figure 2). The group had added an “F” for “further care” that included aspects of care that we thought were pertinent to the oncology patients at FCCC.

The purpose of the FCCC CSI project, titled ABC Delirium: Fighting the Dysfunction Head On, was to adopt the CAM-ICU assessment tool and ABCDE care bundle into practice. The goals of the project were as follows:

- 100% compliance with the CAM-ICU assessment and prevention checklist
- Decrease the use of haloperidol to treat delirium by 50%
- Increase nurses’ comfort and confidence in caring for delirious patients by 65%

Action Plan
The CSI team believed that patients were being given haloperidol as a first-line option for managing the disruptive symptoms of delirium and that the use of this medication could...
be decreased with nurse-driven nonpharmacological measures. Baseline data were obtained for haloperidol use to evaluate the prevalence of pharmacological management of delirious patients. Staff nurses were surveyed to assess their confidence in assessing their patients for delirium and their comfort level in caring for delirious patients. It was important to the CSI team that the nursing outcomes, in addition to patients’ outcomes, were measured to show the impact that this project could have on ICU nurses’ professional practice.

The team launched their project, providing in-service training about the CAM-ICU assessment tool and ABCDE bundle protocol for nurses on the day and night shifts, physicians, managers, and supporting staff. The education included poster sessions and a kick-off breakfast. Staff members received project promotional items of t-shirts, pens, and highlighters. Staff in the ICU

**Figure 1** Confusion Assessment Method for the Intensive Care Unit (CAM-ICU).

<table>
<thead>
<tr>
<th>Acute onset or fluctuating course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the patient different than his/her baseline mental status?</td>
</tr>
<tr>
<td>Has the patient had any fluctuation in mental status in the past 24 hours?</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>CAM-ICU negative</td>
</tr>
<tr>
<td>No delirium</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>&gt;2 errors</td>
</tr>
<tr>
<td>CAM-ICU positive</td>
</tr>
<tr>
<td>Delirium present</td>
</tr>
</tbody>
</table>

**Figure 2** The ABCDE bundle for nonpharmacological management of delirium.

A. Awaken ventilator patients
   Stop sedation to allow waking once daily
   Teaching: daily “sedation vacation” to be done around the same time daily

B. Breathing for ventilator patients
   If patient tolerates awakening, call respiratory therapist for spontaneous breathing trial
   Teaching: patients should undergo continuous positive airway pressure trial while awake, not sedated

C. Choice of sedative: avoid benzodiazepines
   If baseline benzodiazepine user, suggest psychiatric consultation
   For continuous sedation, use propofol or dexmedetomidine; check Ramsay score every 2 hours
   Teaching: proper titration of dexmedetomidine and propofol; use of alternative medications and techniques for agitated patients

D. Delirium detection: monitor with Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) once a shift and document
   If CAM-ICU is positive, consider haloperidol and alert physician (see haloperidol protocol)
   Teaching: CAM-ICU is vital in early detection; it is equally important to alert physician of findings

E. Ambulate 1-3 times a day, stable ventilator patients to chair and stand/walk, use portable ventilator, unstable patients do in-room range-of-motion exercises, physical therapy consultation if needed
   Teaching: Early ambulation is associated with fewer ventilator days and overall shorter stays; orally intubated patients can be walked daily

F. Further care
   Sleep, noise, nutrition/hydration; orientation
   Teaching: these areas were identified as important considerations by the Clinical Scene Investigator team
were granted permission to wear the t-shirts to help promote the project to other interprofessional teams who entered the ICU. Participants were given pens and highlighters with the team logo to help promote the presence of the project and to serve as a catalyst for starting a conversation about delirium. Staff members were educated about the symptoms, prevalence, and long-term consequences of delirium. The team introduced the assessment and new documentation for the CAM-ICU and ABCDE bundle. The ICU nurses were assessed individually on the CAM-ICU to ensure accuracy; each nurse was observed performing the CAM-ICU and constructive feedback was provided. Further education sessions were provided after the 6-month mark and again when the assessment and bundle were introduced in the electronic medical record.

In order to have continuity of buy-in from the important stakeholders of this project, such as the intensivists, respiratory therapists, managers, and surgical and medical physicians, the team reported their progress monthly to the interprofessional ICU committee. This strategy served as a vital communication conduit between the team and its stakeholders. Team members were able to engage in regular conversation with stakeholders to address any issues, showcase the progress that was being made, and garner support.

Results
The team implemented the project and collected data for 6 months. The results surprised everyone. The use of haloperidol decreased by 50% following the implementation of the CAM-ICU and ABCDE bundle (Figure 3). The mean length of stay in the ICU decreased by 0.1 days (Figure 4); the number of days of mechanical ventilation did not change.

A postsurvey of the nursing staff indicated that 80% of staff now felt comfortable caring for delirious patients, which is 36% higher than on the presurvey (Figure 5). The percentage of nurses who were confident in assessing for delirium in ICU patients increased from 15% to 85% after implementation of the CAM-ICU and the ABCDE bundle (Figure 5). Compliance of the clinical staff with the CAM-ICU assessment was less than 60% for 5 months; this time frame reflects multiple unit transitions such as new staff members, management turnover, and introduction of other initiatives. However, the CSI team remained persistent and focused the repeated education in May 2014. The team also implemented a chart in the unit that displayed a mark for each CAM-ICU assessment performed by each nurse; this strategy turned into friendly competition among the staff and boosted the performance of completed CAM-ICU assessments within 1 month of implementation. This effort was reflected in the 100% compliance with the assessment by the end of the CSI academy in July 2014 (Figure 6).

Clinical Implications
The CSI program is lovingly referred to as the gift that keeps on giving at FCCC. The project has catapulted the confidence of the team members in creating change at the bedside. It has empowered one team member to be a bold voice in a
hospital-wide interprofessional initiative to bring delirium assessment and management to all inpatients at FCCC. The same team member also created an interprofessional early mobility program to support the exercise component of the ABCDE bundle. Delirium assessment and management are now embedded into the culture of the ICU at FCCC; adherence to CAM-ICU completion remains greater than 85% (Figure 7).

Nurses report that the CAM-ICU helps them advocate for different medication management when giving report to clinicians. The success of this project exemplified the impact that clinical nurses have on patient care when they are given resources and protected time to work collaboratively to find innovative solutions.

Acknowledgements
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Financial Disclosures
None reported.

Now that you’ve read the article, create or contribute to an online discussion about this topic using eLetters. Just visit www.ccnonline.org and select the article you want to comment on. In the full-text or PDF view of the article, click “Responses” in the middle column and then “Submit a response.”

References
Gahart’s 2017 Intravenous Medications: A Handbook for Nurses and Health Professionals, 33rd edition
Reviewed by Sarah Delgado, RN, MSN, ACNP-BC

Although online resources and smartphone applications are often used in place of pharmacology texts, this reference is a unique and valuable tool for all nurses caring for patients in high-acuity settings. The content, the layout, and even the decision to make the volume spiral-bound so it can be laid flat are all indications of the authors’ commitment to giving essential information to busy nurses providing direct patient care. In addition, the text is coauthored and reviewed by pharmacists with doctoral preparation, providing reassurance in the accuracy of the information.

The book begins with clear instructions on how it is best used, advising readers to use the index to locate specific medications. Although the index is cross-referenced, e.g., antibiotics are listed under “antibacterial agents” and by generic name, all listings refer to a single page number. This avoids the problem of flipping from page to page to answer an urgent question. Locating specific medications is also aided by the use of alphabetical listing, different from texts that group medications by action or by class, which can be more difficult to navigate. The consistency of layout in this book is an additional key asset. All medication monographs follow the same format, with “usual dose,” a frequent concern when confirming the accuracy of a medication order, listed first.

True to its name, this text is clearly specific in meeting the needs of bedside nurses. The content under each medication includes instructions on how to dilute and store the intravenous solutions and available information about compatibility with other intravenous medications. Side effects are described in narrative form, not simply listed, which aids in understanding what is most serious versus what is most common. The section on Precautions is more comprehensive than in standard references created for prescribers, as it includes not only information about pregnancy and nursing mothers, but also what to monitor, patient education, and considerations in elderly patients.

This book is a valuable addition to the nursing station in any facility providing care to high-acuity patients. Nursing leaders on a given unit might consider using bookmarks to identify the most commonly used medications on their unit. In addition, nurses who are transitioning to a new role would find this text a helpful resource as they adjust to administering the medications specific to their new setting. An ideal graduation gift to any nursing student, the volume is available for e-readers as well as in a spiral-bound hard copy.

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Reinventing American Healthcare: How the Affordable Care Act Will Improve Our Terribly Complex, Blatantly Unjust, Outrageously Expensive, Grossly Inefficient, Error Prone System


For anyone seeking to understand the Affordable Care Act (popularly known as ACA or ObamaCare), this book is an excellent choice. The first chapters provide background information, including a history of health policy in the United States and a description of the diverse incentives that lead to the complex payment system of today. The author then explains the rationale for the ACA and the contentious process by which it became law. In the final sections of the book, he explains how the law will be implemented over time and predicts the impact it will have on the cost, quality, and accessibility of our health care system. To illustrate his points, the author provides case studies that show the gaps of our current health care system and how the ACA will change the lives of people facing acute and chronic health problems. The author is a physician, a bioethicist, and a health policy expert, but the narrative style and the clear explanations make this book appropriate for health care experts and consumers alike—an informative and interesting read.

Peds Pearls: Tear-Out Tips, Tricks, and Treasures From the Trenches


This text offers a unique format for delivering information about a wide range of pediatric emergencies. Instead of the usual textbook layout, the book contains a group of tear-out pages that can be posted in a common area to share information with all members of the health care team. Eye catching graphics and simple explanations make the content easy to read and absorb during a short break in a busy shift. In addition, the author provides mnemonics, such as “the ABCs” for pediatric asthma and “the rule of 9’s” to evaluate the extent of a burn injury. Most of the posters end with a “moral of the story,” a key take-home point about the condition discussed. This book would be useful in pediatric settings to provide all members of a health care team with up-to-date information about emergency situations.
Alaska

Anchorage
CCRN/PCCN Review
Date: November 3-4, 2016. Place: Anchorage, AK. Keynote Speaker: Nicole Kupchik. Sponsor: South Central Alaska Chapter of AACN. Contact: Michelle Husberg. Phone: (907) 264-1546. E-mail: michelle@husberg.net. Credits: 15 CEUs

California

San Diego
Pediatric Critical Care & Emergency Nursing

Florida

Miami
TCRN Review Course
Date: October 21-22, 2016. Place: Nova Southeastern University. Address: 8585 SW 124th Ave, Miami, FL 33183. Keynote Speaker: Kendra Menzies. Sponsor: Greater Miami Area Chapter of AACN. Contact: Ruth Salathe. Phone: (305) 617-4030. E-mail: ruthsalathe@gmail.com. Fee: Members, $180; nonmembers, $195; groups of 3, $170 each (applies only if registrations received together). Credits: 14 CEUs

Plantation
42nd Annual Spring Seminar
Date: April 1, 2017. Place: Renaissance Hotel. Address: 1230 S Pine Island Rd, Plantation, FL 33324. Keynote Speakers: Clareen Wiencek, Kendra Menzies, Kent Douglas. Sponsor: Broward County Chapter of AACN. Contact: Patty Kelly. Phone: (954) 722-8020. E-mail: pattyskelly7@att.net. Fee: Before March 14, member, $75; nonmember, $100. After March 14, member, $100; nonmember, $125. At the door, member, $125; nonmember, $150. Credits: 6.5 CEUs

Kentucky

Louisville
Annual Chapter Symposium Nursing in the New Millennium: Basing Your Practice on the Evidence
Date: October 14, 2016. Place: Baptist Health Louisville. Address: 4000 Kresge Way, Louisville, KY 40207. Keynote Speaker: Kathleen Vollman. Sponsor: Greater Louisville Chapter of AACN. Contact: Deb Tuggle. Phone: (502) 500-5010. E-mail: deborah.tuggle@gmail.com. Fee: Member, $60; nonmember, $75; student (prelicensure), $25. Credits: 7.5 CEUs

For Education Directory submission guidelines contact CCN Education Directory, 101 Columbia Aliso Viejo, CA 92656 (800) 899-1712 E-mail: ccn@aacn.org.
Why did you become a nurse?
I’ve wanted to be a nurse for as long as I can remem-
ber. I have a photo from kindergarten showing me in a
white cap and dress caring for a patient in bed. The photo
caption reads, “When I grow up I want to be a nurse.”

What about your job as a nurse makes you happy?
I love my job as an open heart nurse. For the first
time in my life my passion helps contribute to my com-
community. I have helped to start an open heart program
in our town. I feel strongly about building something
that will save lives long after I’m gone. I live on another
island and fly to Oahu, by choice, to work. I do it
because traveling back and forth is worth it in order to
belong to a caring community.

Tell us about an extraordinary experience you’ve had as a critical care nurse.
One woman stands out. She knew she didn’t have
many days left to live and created a bucket list. On that
list was her baptism. Despite her poor physical health,
the ventilator, and the drips, I wanted her to feel beauti-
ful on her special day. Our staff arranged and paid for a
hairdresser and makeup artist to prepare her for her
baptism. That day was one of our busiest, but we
picked up the slack for each other and waived our
breaks to pull off the baptism. I’ll never forget her
bright red lipstick and perfectly cut and styled hair.
When she mouthed “thank you,” she spoke louder
than any other words I’ve heard. She died the following
week. Intensive care medicine is so much more than
codes and vital signs; it’s also about loving and
making a difference in life and in death.

What are the challenges you encounter and how do you overcome them?
The acuity is high and patient loads are heavy where I
work. The need to create a happy work environment for
our patients and ourselves has become paramount to our
job satisfaction and longevity. Laughter, genuine team
work, and going the extra mile for each other is how you
get through a rough shift and leave feeling a true sense of
accomplishment and satisfaction. We need each other.

What has your journey as a nurse been like?
My journey has been full of learning. The longer I’ve
been a nurse, the more I embrace the fact that we never
really “arrive.” Medicine is not stagnant; it’s fluid and chang-
ing. Learning and education should always be a big part of
our career.

At the end of a busy day, how do you find balance in your life?
I have a husband who fully supports my passion as a
nurse. I come home to a great foot massage and solid
shoulders to rest on.

What would we be surprised to know about you?
I work on Oahu but I live on the small island of Molokai
in an 180 square foot home with no electricity and no run-
ning water. There’s something magical about being totally
free of technology and lost in nature; it allows me to refuel
and refocus.

How has AACN played a role in your career?
I take full advantage of the education and resources
available to me through AACN. NTI has inspired me to go
back to school. I’m currently pursuing my nurse practitioner
degree and hope to continue on to a DNP degree. I adopted
the theme of “Be the Change” from a previous NTI to be my
life motto. CCN
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Smoflipid is indicated in adults as a source of calories and essential fatty acids for parenteral nutrition when oral or enteral nutrition is not possible, insufficient, or contraindicated.

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• The usual daily dosage in adults is 1 to 2 grams/kg per day and should not exceed 2.5 grams/kg per day

CONTRAINDICATIONS
• Known hypersensitivity to fish, egg, soybean, or peanut protein, or to any of the active ingredients or excipients.
• Severe hyperlipidemia or severe disorders of lipid metabolism with serum triglycerides > 1,000 mg/dL.

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• Infection, Fat Overload, Hypertriglyceridemia, and Refeeding Complications: Monitor laboratory parameters.
• Aluminum Toxicity: Patients with renal impairment, including preterm infants are at increased risk.
• Parenteral Nutrition-Associated Liver Disease: Increased risk in patients who receive parenteral nutrition for extended periods of time, especially preterm infants. Monitor liver function tests, if abnormalities occur consider discontinuation or dosage reduction.

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PLEASE SEE ADDITIONAL IMPORTANT SAFETY INFORMATION ON NEXT PAGE.

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See full prescribing information for complete boxed warning.

• Deaths in preterm infants have been reported in literature.
• Autopsy findings included intravascular fat accumulation in the lungs.
• Preterm and low-birth-weight infants have poor clearance of intravenous lipid emulsion and increased free fatty acid plasma levels following lipid emulsion infusion.