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INSIDE

Practice Makes (Almost) Perfect: Reducing Catheter-related Bacteremia Using Simulation-based Training

ABSTRACT & COMMENTARY

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Dr. Muder does research for Aventis and Pharmacia.

This article originally appeared in the September 2009 issue of Infectious Disease Alert. *It was edited by Stan Deresinski, MD, FACP, and peer reviewed by Connie Price, MD. Dr. Deresinski is Clinical Professor of Medicine, Stanford University; Associate Chief of Infectious Diseases, Santa Clara Valley Medical Center, and Dr. Price is Assistant Professor, University of Colorado School of Medicine. Dr. Deresinski serves on the speaker's bureau for Merck, Pharmacia, GlaxoSmithKline, Pfizer, Bayer, and Wyeth, and does research for Merck, and Dr. Price reports no financial relationships relevant to this field of study.*

Source: Barsuk JH et al. Use of simulation based education to reduce catheter-related bloodstream infections. *Arch Intern Med*. 2009;169:1420-1423.

In order to reduce the rate of catheter-related bloodstream infections (CRBSIs) in intensive care units, Northwestern Memorial Hospital implemented patient-care bundles in all ICUs in August 2005. The bundles included use of hand hygiene, full body drapes, use of chlorhexidine as a skin disinfectant, and sterile technique by the operator. Resident physicians performed 98% of catheter insertions; all residents were given didactic training in correct insertion procedures.

Beginning in December 2006, internal medicine and emergency medicine residents, who provided care in the medical ICU, underwent simulation-based training in central-venous catheter insertion prior to their ICU rotations. In addition to lectures on indications, insertion techniques, and complications, residents received a step-by-step demonstration of catheter-insertion techniques emphasizing evidenced-based guidelines for reducing CRBSIs embodied in the patient-care bundle. Following this, they received three hours of training using an ultrasound device and patient simulator. Residents were

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required to achieve a minimum passing score; those that did not performed an extra hour of practice. All ultimately passed. During this period, surgical residents continued to receive the original didactic training but did not receive simulation-based education.

Barsuk et al compared CRBSI rates for the pre- and post-simulation-based education periods, and compared the rates in the MICU and SICU. The rate of CRBSIs in the MICU was 3.20/1,000 catheter-related days in the pre-intervention period, compared with 0.50/1,000 patient days in the post-intervention period. In the SICU, the rate was 4.86/1,000 patient days in the first period and 5.26/1,000 patient days in the second period.

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There are approximately 80,000 CRBSIs in the United States annually, with an attributable mortality of up to 25%. Both conscientious adherence to sterile technique at the time of insertion and use of antimicrobial-impregnated devices may reduce the risk of CRBSIs. The study by Barsuk et al demonstrates convincingly that a program of simulation-based education in catheter insertion for physicians in training has a dramatic effect in reducing infection rates. Although the study was not randomized, and used a partial pseudo-experimental ("before and after") design, the degree in the infection rate, 85%, is truly striking. It's also notable that the CRBSI rate in the surgical ICU, in which the training was not offered, did not decline, and actually showed a small increase. As there were no other initiatives in place to decrease CRBSIs, and the patient illness scores appeared not to have changed over time, one must conclude that the education was effective.

What is not clear from the report is what aspects of the education were essential. It might have been the increased emphasis on sterile technique or the increased skill at insertion gained by the trainees. The latter could lead to quicker insertion times, fewer needle sticks with attendant tissue trauma, and increased facility with maintaining a sterile field. Regardless, the benefits of the educational program are clear. Thirty years ago (yes it's really been that long!), when I was a resident in a busy ICU, I learned how to place a catheter under the old "see one, do one, teach one" system, which undoubtedly was an effective means to propagate all of the faulty techniques learned by more senior residents. Given the current, appropriate attention to patient safety, the alternative approach described by Barsuk et al is welcome. ■

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Questions & Comments

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Respiratory Therapist-driven Protocol for Non-ICU Surgical Patients Reduces ICU Use and Decreases Costs

ABSTRACT & COMMENTARY

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Dr. Pierson reports no financial relationships relevant to this field of study.

This article originally appeared in the September 2009 issue of Critical Care Alert. *It was edited by William Thompson, MD. Dr. Thompson is Staff Pulmonologist, VA Medical Center; Associate Professor of Medicine, University of Washington; he reports no financial relationships relevant to this field of study.*

Synopsis: *Initiation of a respiratory therapist-driven protocol for assessment and management of risk for respiratory complications in the study hospital's neurosurgery step-down, trauma/surgery step-down, and trauma/surgery general units was followed by an increase in the number of patients receiving respiratory treatments, but decreases in ICU and hospital stays and overall hospital costs.*

Source: Harbrecht BG, et al. Improved outcomes with routine respiratory therapist evaluation of non-intensive-care-unit surgery patients. *Respir Care* 2009;54: 861-867.

Harbrecht et al, at the University of Pittsburgh, studied the effects of a targeted protocol for respiratory assessment and management in patients admitted to the hospital's neurosurgery step-down, trauma/surgery step-down, and trauma/surgery general units. The protocol, which did not require a physician's order, focused on early identification of patients at risk for pulmonary complications and provision of respiratory therapy and bronchodilator aerosol. Patients admitted to the study units were evaluated by a respiratory therapist (RT) using a standardized assessment tool, by means of which they were assigned a risk score from 0 to 4. Based on the score assigned, patients then could automatically receive therapy according to one or more standardized protocols (bronchodilator therapy, hyperinflation therapy, or secretion management), with the responses assessed by the RT and adjustments to therapy made as deemed necessary according to the protocol. The investigators collected data on all patients admitted to the study units for eight months prior to and eight months after initiation of the protocol.

Patient admissions to the three units were 2,230 during the control period prior to implementation of the RT-driven protocol and 2,805 in the following eight months. During the second period, the units' patients were slightly older and had somewhat greater comorbidities according to Charlson score, but the groups were otherwise similar. There were no significant differences in overall mortality or in the proportion of patients (about 3%) who required transfer to the ICU. However, after protocol initiation, a greater number and proportion of patients received respiratory treatments (48% vs. 30%, respectively; $p < 0.01$), and patients receiving respiratory treatments had shorter ICU (2.3 vs. 3.6 days; $p < 0.002$) and hospital (6.8 vs. 7.8 days; $p < 0.02$) stays and decreased total hospital costs ($17,000 vs. $20,300; $p < 0.01$).

■ COMMENTARY

Previous studies have shown that RT-driven protocols shorten weaning time and prevent ventilator-associated pneumonia in the ICU. Outside the ICU, such protocols have also been shown to improve the process of care — increasing adherence to hospital standards and decreasing inappropriate therapy — but there has been little evidence of a positive effect on patient outcomes. Although the effects of protocol implementation in this study were modest, a positive impact on potentially important outcomes — time spent in the ICU and in the hospital, and overall hospital costs — was demonstrated.

Implementation of RT-driven protocols in the ICU and elsewhere in the hospital are sometimes met with resistance on the part of physicians. Typical objections are that protocols "take patient management out of my hands," or "don't apply to my patients," or interfere with the teaching of students and residents. As intuitive as they appear on the surface, however, these objections are not valid. An appropriately devised protocol, duly tailored to the institution's patient population, and reflective of local practice patterns, actually improves the delivery of care as physicians say they want it done. Effective protocols are developed locally, with allowance for local preferences. Although many protocols have been developed around the world, and many templates are available for use in developing local versions, those that prove most effective are individualized to the patients and practice in the specific institution or unit. In addition, protocols have generally been shown to improve, rather than impede, medical education, through their consistency and the application of best evidence in bedside care. A lot of clinicians, like people in general, tend to be resistant to change. Formal studies and experience alike show that staff participation and satisfaction with protocols tend to increase over time once they are in place and their benefits begin to become apparent. ■

Cleaning Stethoscopes with Ethanol-based Cleaner vs. Isopropyl Alcohol — Which Is Better?

ABSTRACT & COMMENTARY

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Dr. Wall reports no financial relationship to this field of study.

This article originally appeared in the September 2009 issue of Critical Care Alert. *It was edited by David J. Pierson, MD, and peer reviewed by William Thompson, MD.*

Synopsis: *This study showed that cleaning a stethoscope with an ethanol-based foam hand cleaner is as effective as wiping it with an isopropyl alcohol pad.*

Source: Lecat P, et al. Ethanol-based cleanser versus isopropyl alcohol to decontaminate stethoscopes. *Am J Infect Control* 2009;37:241-243.

For many years, infection-control experts have focused on improving the hand-hygiene habits of health care providers. This before-and-after observational study is an extension of that work, namely focusing on the hygiene of stethoscopes used for routine patient care. The study

compared the effectiveness of cleaning stethoscopes with two different agents — a foam ethanol-based hand cleaner (EBC) vs. isopropyl alcohol pads (IPA). The objective was to determine the effectiveness of each agent in reducing bacterial contamination of stethoscope diaphragms.

The study was conducted in a 600-bed academic medical center. Stethoscopes were taken from a convenience sample of 99 providers (55 nurses, 42 physicians, two students) on general medical floors. Stethoscopes were cultured by pressing the diaphragm onto a blood agar plate. Each stethoscope was cultured before and after cleaning with one of the two agents. Overall, 49 stethoscopes were cleaned with EBC and 50 stethoscopes were cleaned with IPA. Between platings, every participant cleaned his/her hands using two metered aliquots of EBC foam from an automatic wall dispenser. For EBC testing, participants rubbed their hands with EBC and then rubbed the entire stethoscope diaphragm between their hands. For IPA testing, participants rubbed their hands with EBC and then wiped the diaphragm in a circular pattern five times using an IPA pad. All stethoscopes were air-dried for 60 seconds after cleaning.

At baseline, every stethoscope grew bacteria prior to cleaning. The predominant bacteria seen in the cultures were gram-positive bacilli (80%), non-aureus *Staphylococcus* (75%), methicillin-sensitive *S. aureus* (3%), and group A *Streptococcus* (1%). No stethoscope grew methicillin-resistant *S. aureus* (MRSA) at baseline.

After cleaning, 28% of the stethoscopes were completely sterile. Of the remaining culture-positive stethoscopes, 81% grew gram-positive bacilli and 19% grew non-aureus *Staphylococcus*. There were no statistical differences in bacterial counts between the two cleaning agents (p = 0.25). Both agents dramatically reduced the number of colony-forming units on the agar plates by 93%, when compared with baseline ($p < 0.0001$). Neither agent was statistically superior to the other.

■ COMMENTARY

Nosocomial infections claim nearly 100,000 U.S. patient lives annually. In fact, the CDC estimates that one in 20 hospital admissions is complicated by a health care-associated infection (HAI).[1] Like hand hygiene, stethoscope hygiene should be viewed as an essential component of reducing these infections. Indeed, the stethoscope is merely an appendage of the provider.

I like this study because it is simple but clinically relevant. The baseline contamination rate of 80% for stethoscopes is consistent with numerous studies dating back to the 1990s. Those older studies also revealed a high load of *Staphylococcus* species on stethoscopes. Given such knowledge, it seems ridiculous for providers to "foam-in, foam-out" of patient rooms, but then toss a contaminated stethoscope around their neck or into their coat pocket.

I believe stethoscope hygiene should be viewed as an integral component of hand hygiene. This study shows that using a foam-based EBC is just as effective as wiping with an IPA pad. The additional time required is minimal. Hopefully, this convenience factor will encourage providers to cleanse their stethoscopes more regularly.

Despite the focus of this article, hand and stethoscope hygiene is only the tip of the HAI iceberg. Studies have shown potentially high rates of bacteria on numerous objects, including neckties, white coats, nurse uniforms, writing instruments, computer keyboards, wash basins, and nametags. I must confess I often worry about the bacterial load in my own coat pocket where I carry my stethoscope. Within a few days of working in our ICU, I can only imagine the frightening cross section of bacteria that might be lurking in there. This study should encourage each of us to clean our stethoscope both before and after patient care, just like our hands. ■

Reference

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Unexplained Cardiac Arrest Evaluation

ABSTRACT & COMMENTARY

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Dr. DiMarco is a consultant for Novartis, and does research for Medtronic and Guidant.

This article originally appeared in the September 2009 issue of Clinical Cardiology Alert. *It was edited by Michael H. Crawford, MD, and peer reviewed by Ethan J. Weiss, MD. Dr. Crawford is Professor of Medicine, Chief of Cardiology, University of California, San Francisco, and Dr. Weiss is Assistant Professor of Medicine, Division of Cardiology and CVRI, University of California, San Francisco. Dr. Crawford is on the speaker's bureau for Pfizer, and Dr. Weiss reports no financial relationships relevant to this field of study.*

Source: Krahn AD, et al. Systematic assessment of patients with unexplained cardiac arrest: Cardiac Arrest Survivors with Preserved Ejection Fraction Registry (CASPER). *Circulation*. 2009;120:278-285.

In this paper, Krahn et al, from a Canadian consortium, report on the results of systematic evaluations in patients with unexplained cardiac arrest due to ventricular tachycardia or ventricular fibrillation. Patients were eligible for inclusion if they had normal left ventricular function, no severe hypertrophy, normal coronary arteries, long QT syndrome (LQTS), or if Brugada syndrome could not be diagnosed based on their resting ECG and no reversible cause for cardiac arrest had been identified. Patients were enrolled between January 1, 2004 and October 1, 2008, in eight adult and one pediatric electrophysiology center in Canada. Patients who were candidates for the study underwent continuous ECG monitoring, transthoracic echocardiography, and coronary angiography. Patients, where the cardiac arrest remained unexplained, were evaluated using a standardized testing protocol that included a signal averaged ECG, exercise testing, cardiac magnetic resonance imaging, and intravenous drug challenges with epinephrine and procainamide. Patients also underwent electrophysiologic studies with programmed ventricular stimulation using up to three ventricular extrastimuli at two drive cycle lengths. Voltage mapping, right ventricular angiography, and right ventricular biopsy were conducted if occult arrhythmogenic right ventricular cardiomyopathy (ARVC) was suspected. Finally, targeted genetic testing was performed on the basis of phenotype detection. Genetic testing was performed on culprit genes for LQTS, Brugada syndrome, ARVC, and catecholaminergic polymorphic ventricular tachycardia (CPVT).

Sixty-three patients were included in the study. The mean age was 43 ± 13 years; 29 patients were female (46%). Specific diagnoses were made in 35 of 63 patients (56%). The cardiac arrest remained unexplained in the remaining 28 patients (44%). A variety of abnormalities were detected. LQTS was detected in eight patients (23%), CPVT in eight (23%), ARVC in six (17%), early repolarization in five (14%), coronary spasm in four (11%), Brugada syndrome in three (9%), and myocarditis in one (3%). Imaging was positive in eight patients, provocation with either exercise or drug infusion in 18, and voltage mapping or ventricular biopsy in three. Coronary spasm was diagnosed in four patients who spontaneously had greater than 2 mm of ST segment elevation during inpatient telemetry. Family screening was performed in 64 family members of nine patients who had causative mutations. Fifteen of these 64 family members were found to have previously undiagnosed mutations that could lead to cardiac arrest.

Krahn et al conclude that the cause of a previously unexplained cardiac arrest can be determined in about half of all such patients with the use of systematic noninvasive and invasive testing. Drug provocation and advanced imaging modalities had the greatest yield. Positive results can direct genetic testing among family members for genetically mediated arrhythmia syndromes.

■ **COMMENTARY**

In most series of out-of-hospital cardiac arrest survivors, about 3%-10% of patients have no apparent structural heart disease identifiable. In some of these patients, the resting ECG provides a diagnosis that can be used to guide therapy but, in others, the ECG and monitoring will be only inconclusive. In this report, Krahn and a group of investigators from nine Canadian centers show that a systematic diagnostic approach can efficiently and accurately identify the cause for cardiac arrest in about 50% of cases. The knowledge gained can then be used to guide therapy both in the patient and, perhaps more importantly, in potentially affected family members.

The greatest yield was seen with provocative tests using either exercise or drug infusions. In patients with LQTS, CPVT, and Brugada syndrome, the baseline ECG may be normal, and it is only with provocative testing that the diagnosis can be made. Electrophysiologic study is rarely helpful in patients with a normal resting ECG and normal cardiac function.

The four patients with spasm-induced arrhythmias are an interesting group. Spasm may occur both with and without a definable underlying coronary stenosis. However, spasm must be suspected and treated when chest pain precedes the arrest and no significant coronary disease is seen with angiography.

Despite the protocol followed by Krahn et al, 44% of the cardiac arrests remained unexplained. Whether these patients have a previously unrecognized condition, or the arrest was the response of a truly normal heart to some unknown irritant, will require future studies looking at this interesting group of patients. ■

Whole Blood in the Management of Hypovolemia Due to Obstetrical Hemorrhage

ABSTRACT & COMMENTARY

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Dr. Hobbins reports no financial relationship to this field of study.

This article originally appeared in the September 2009 issue of OB/GYN Alert.

It was edited by David J. Pierson, MD, and peer reviewed by William Thompson, MD. Dr. Pierson is Professor, Pulmonary and Critical Care Medicine, Harborview Medical Center, University of Washington, and Dr. Thompson is Staff Pulmonologist, VA Medical Center; Associate Professor of Medicine, University of Washington. Drs. Pierson and Thompson report no financial relationships relevant to this field of study.

Synopsis: *The concept of abandoning the use of whole blood in favor of packed cells for the treatment of hypovolemia in obstetric hemorrhage should be questioned in view of this study's suggestion of a lower rate of acute tubular necrosis in patients treated with whole blood.*

Source: Alexander JM, et al. Whole blood in the management of hypovolemia due to obstetric hemorrhage. *Obstet Gynecol* 2009;113:1320-1326.

If I were asked to name the four most prominent clinical leaders in obstetrics in the United States during its formative years, they would be Hon, Quilligan, Zuspan (who, sadly, passed away in June), and Pritchard. The latter giant led an incredibly productive group at Parkland Hospital in Dallas for years, and developed protocols that are still ingrained in obstetrical practice today. He was a stickler for aggressively treating obstetrical hemorrhage, resulting from abruption or other causes, with whole blood. However, for a variety of reasons, the current tendency is to break down a unit of blood into component parts, with packed cells being utilized for pure hemorrhage, and platelets, fibrinogen, or fresh frozen plasma being used for other specific needs. Since the rationale for this approach was that one could get more uses out of one pint of blood and that the non-red cell products could be pooled, this resulted in a major drop-off in the availability of whole blood.

Rather than succumb meekly to this trend, the group in Dallas conducted this study to pit whole blood against packed cells, with or without other blood components, in the treatment of maternal hypovolemia due to obstetrical hemorrhage. Charts were reviewed from 1,540 patients who were transfused over a four-year period (2002-2006). The choice of blood products was based on availability. Many of those receiving whole blood had an immediate need for replacement before typing could be accomplished, and they received O negative blood.

Six hundred and fifty-nine received whole blood only, 593 received packed red cells only, and 208 received red cells with component products. The endpoints evaluated were: acute tubular necrosis (ATN), adult respiratory distress syndrome, pulmonary edema, hypofibrinogenemia, admission to the ICU, and death.

The group receiving combination therapy was in a severity class of its own, requiring, on average, double the amount of whole blood or packed cells than the other two groups. These patients also had a 2-8-times higher rate of the above complications compared with the other groups. When comparing the whole blood vs. packed cell groups, the outcomes were comparable in every category, including average amount of transfused units (2.3 vs. 2.2). However, there was a lower incidence of ATN (0.3% vs. 2%; $p = 0.001$) and a higher incidence of pulmonary edema (7% vs. 4%; $p = 0.001$) for those getting whole blood.

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The conclusion to be reached was that 10 of the 12 cases of ATN (not receiving combination therapy) might have been avoided if whole blood had been used instead of packed cells. This could easily counter the doubling of pulmonary edema in the whole blood group, since all of these cases were successfully treated without consequences, as opposed to the more serious potential aftermath of ATN.

At the end of the paper, the authors lapsed into an interesting discussion on the use of blood products in soldiers in Iraq suffering from acquired coagulopathy from battlefield injuries.[1] In 87 seriously injured soldiers, packed cells had a tendency to foster coagulopathy by not correcting platelet abnormalities, while whole blood appeared to correct the coagulopathy. Lastly, 1 unit of whole blood limits patient exposure to only one individual's blood, rather than to the blood of many individuals when combination replacement is required.

For all of the above reasons, the Dallas group made a reasonable argument for bringing back, or certainly not abandoning, the use of whole blood for replacement therapy in obstetrical hemorrhage. ■

Reference

1. Spinella PC, et al; 31st CSH Research Working Group. Fresh whole blood transfusions in coalition military, foreign national, and enemy combatant patients during Operation Iraqi Freedom in a U. S. combat support hospital. *World J Surg* 2008;32:2-6.

Vancomycin Loading Doses in Morbidly Obese Patients

ABSTRACT & COMMENTARY

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Jessica C. Song reports no financial relationships relevant to this field of study.

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Disease Alert. *It was edited by Stan Deresinski, MD, FACP, and peer reviewed by Connie Price, MD.*

In January 2009, the publication of an updated vancomycin monitoring guideline[1] gave clinicians a set of recommendations on: 1) timing of monitoring, 2) optimal trough concentration, 3) dosing to achieve optimal trough concentrations, 4) loading doses for complicated infections, 5) criteria for monitoring, and 6) frequency of monitoring. The recent vancomycin therapeutic monitoring guideline, a joint publication from the American Society of Health-System Pharmacists and the Infectious Diseases Society of America (IDSA), advocated the use of a loading dose of 25-30 mg/kg (based on actual body weight) for patients with complicated infections (IIIB level of evidence/grade of recommendation). Of note, this recommendation was based on expert opinion and descriptive studies and, hence, remains somewhat controversial.

Over the past two decades, the prevalence of morbid obesity has nearly doubled, from 2.9% in 1988-1994 to 4.7% in 1999-2000.[2] Morbid obesity, defined as a body mass index of 40 kg/m^2 or more,[2] can pose a challenge to clinicians who must develop optimal antimicrobial drug-dosing regimens. Moreover, the use of standard formulae for calculating the creatinine clearance (Clcr) does not apply to morbidly obese patients, given the lack of validation of such methods in this population.[3]

The purpose of this review is to discuss the pharmacokinetics of vancomycin observed in morbidly obese patients and to provide recommendations on loading doses of this drug in this patient population.

Pharmacokinetics in Obese Patients

The development of an optimal dosing regimen of vancomycin (loading and maintenance doses) is dependent upon volume of distribution (Vd), clearance, and half-life in order to produce maximum efficacy and minimal toxicity.[4] Unfortunately, the altered physiologic state of morbidly obese patients, along with inter-individual variations in this population, cause the relevant pharmacokinetic parameters to change significantly.[5]

The Vd represents a key parameter in determining the loading dose of drugs that require more rapid attainment of therapeutic serum concentrations.[1,4] The volume of distribution of vancomycin has been shown to approach 0.7 L/kg in non-obese patients, using total body weight (TBW) for calculating Vd.[4,5] In contrast, Bauer et al[5] found that using TBW in 24 morbidly obese patients (average weight, 165 kg) yielded a mean Vd of 0.32 L/kg. Similarly, Blouin et al[6] determined that the Vd of six morbidly obese patients (TBW, 111-226 kg) was approximately 0.26 L/kg.

The differences in Vd observed in obese patients compared with non-obese patients may be due to the fact that Vd is a function of the physiologic volume of blood and organs, along with drug binding in the blood and organs. While obese patients have large quantities of excess adipose tissue, the increased size of their body organs and larger blood volumes contribute to higher Vds. Moreover, adipose tissue does contain extracellular fluid to which vancomycin may distribute.[5]

Another important physiologic alteration noted in morbidly obese patients is creatinine clearance, a surrogate marker of glomerular filtration rate. Because of their larger kidneys, obese patients have a greater number of functional nephrons than non-obese patients. Consequently, the clearance of vancomycin, a renally eliminated drug, has been shown to be accelerated in morbidly obese patients.[5] Salazar et al devised a method for estimating creatinine clearance in morbidly obese patients, as standard methods such as the Cockcroft-Gault equation do not yield accurate creatinine clearances in this patient population.[3] Salazar et al used an equation to calculate creatinine clearances in morbidly obese males and females.

Changes in Vd and clearance ultimately shorten the half-life of vancomycin in morbidly obese patients.[5] Because of the markedly accelerated clearance found in obese patients without a commensurate modification in Vd, the half-life of vancomycin has been shown to be considerably shorter (3.3 hours) in obese patients, compared with non-obese patients (7.2 hours).[5]

On the basis of the data from published pharmacokinetic studies of vancomycin, morbidly obese patients may require larger doses (> 1 gram) and shorter dosage intervals (6-8 hours) compared with non-obese patients, in order to achieve target serum trough concentrations.

Loading Dose of Vancomycin

There is limited data regarding the administration of vancomycin loading doses in critically ill, morbidly obese patients. If clinicians follow the IDSA recommendation of a loading dose of 25 mg/kg in a 200 Kg patient, a dose of 5 grams would need to be administered, given that total body weight has been shown to be a more accurate predictor of vancomycin pharmacokinetic parameters. However, since rapid infusion (< 1 hour) of first-dose vancomycin can cause red man syndrome,[7] an infusion-related reaction that consists of facial, neck, and

upper trunk pruritus, infusion times of at least a few hours would be required to deliver loading doses to obese patients.

Many institutions have limited the maximum loading dose of vancomycin to 2,000 mg.

Of note, the IDSA recommends extension of infusion times to 1.5 to 2.0 hours when individual doses exceed 1 gram (i.e., 1.5 and 2.0 grams).[1]

Some clinical pharmacokinetic specialists[4] estimate the appropriate loading dose to achieve an initial vancomycin concentration of 30 mg/L.

Conclusion

As a population, morbidly obese patients exhibit numerous physiologic changes that can impact dosing of antimicrobial agents, such as vancomycin. As a result, the pharmacokinetics, as well as dose requirements of vancomycin differ considerably in obese patients, compared with non-obese patients. Therapeutic drug monitoring helps to individualize therapy to the patient, as well as accommodate the patient's physical condition (renal function, age, body weight). ■

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CME Questions

4. According to the study by Krahn et al, patients with ventricular tachycardia, or ventricular fibrillation that was unexplained after a basic work-up, had a specific diagnosis made by advanced diagnostic modalities in approximately what percentage of patients?

a. 25%
b. 50%
c. 67%
d. 85%

5. In the study by Lecat et al., which of the following was true?

a. Before cleaning, all stethoscopes grew bacteria when cultured.
b. Ethanol-based foam cleaners were more effective than isopropyl alcohol pads in reducing bacterial colony counts on the stethoscopes.
c. Isopropyl alcohol pads were more effective than ethanol-based foam cleaners in reducing bacterial colony counts on the stethoscopes.
d. After cleaning, all stethoscopes were sterile when cultured.

6. In the trial described by Harbrecht et al, compared to patients not managed by the protocol, non-ICU surgical patients who were managed by the respiratory-driven protocol were more likely to have which of the following?

a. Increased total hospital costs
b. Decreased mortality
c. Longer length of hospital stay
d. More respiratory treatments

Answers: 4. (b); 5. (a); 6. (d)

CME Objectives

The objectives of *Hospital Medicine Alert* are to:

• review pertinent safety, infection control, and quality improvement practices;

• discuss diagnosis and treatment of acute illness in the hospital setting; and

• review current data on diagnostic and therapeutic modalities for common inpatient problems. ■