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CRITICAL CARE ALERT®

A monthly update of developments in critical care and intensive care medicine

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How Often Should Ventilator Circuits be Changed?

ABSTRACT & COMMENTARY

Han and colleagues investigated whether decreasing ventilator circuit changes from every 2 days to every 7 days would impact ventilator-associated pneumonia rates. All mechanically ventilated patients at Peking Union Medical College Hospital in China were studied over a 21-month period. From March 1998 to February 1999, ventilator circuits were changed every 2 days, and from June 1999 through December 1999, ventilator circuits were changed every 7 days. Nosocomial pneumonia was identified using the criteria of the Centers for Disease Control. In the 2-day-change group, there were 2277 ventilator-patient days and 38 patients developed pneumonia, resulting in a pneumonia rate of 16.7 cases per 1000 ventilator days. The 7-day-change group accumulated 972 ventilator days and 8 patients contracted pneumonia, resulting in a pneumonia rate of 8.2 cases per 1000 ventilator days. The pneumonia rate was significantly lower in the 7-day-change group ($P = 0.007$). To standardize for seasonal variability, results were compared from the same seasonal time frames (June 1998 to December 1998 for the 2-day-change group, and June 1999 to December 1999 for the 7-day-change group), and obtained similar findings; during those periods, pneumonia rates were 24.2 cases per 1000 ventilator days for the 2-day-change group and 8.9 cases per 1000 ventilator days for the 7-day-change group ($P = 0.001$). It is concluded that a circuit-change interval of 7 days had a lower risk of ventilator-associated pneumonia (VAP) than a 2-day change interval. (Han JN, et al. Effects of decreasing the frequency of ventilator circuit changes to every 7 days on the rate of ventilator-associated pneumonia in a Beijing hospital. *Respir Care*. 2001; 46[9]:891-896).

COMMENT BY DEAN R. HESS, PhD, RRT

It has become increasing recognized that VAP is unlikely to be related to the ventilator or the ventilator circuit per se. Patients are more likely to develop VAP from secretions aspirated past the cuff of the endotracheal tube than by what is breathed through the endotracheal tube. It is not surprising, then, that the rate of VAP has been reported to be decreased if subglottic secretions are aspirated so that

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they cannot be aspirated into the trachea. Moreover, reduced rates of VAP have been reported when noninvasive ventilation is used (therefore, no endotracheal tube) compared to invasive ventilatory support.

Over the past 15 years, there have been both observational studies[1-5] and randomized, controlled trials[6-9] reporting the effects of less frequent ventilator circuit changes. As individual studies, no significant differences in VAP have been reported when circuit change intervals have been lengthened. Several studies have now reported no change in VAP rates when circuits are only changed on an at-needed basis. It is interesting to note that no change in VAP rate occurred when inline suction catheters are changed on an as-needed basis rather than on a daily basis.[10] For nearly 5 years, it has been the practice at the Massachusetts General Hospital to change ventilator circuits and inline suction catheters on an as-needed basis (and, of course, between patients).

I recently used the tools of evidence-based medicine and meta-analysis to explore the effects of less frequent ventilator circuit changes on the development of VAP. For the observational studies,[1-5] the risk of VAP is significantly reduced ($P = 0.04$) for less frequent circuit changes (odds ratio, 0.79, 95% CI, 0.63-0.99). For the randomized controlled trials,[6-9] the risk of VAP is also significantly reduced ($P = 0.03$) for less frequent circuit changes (relative risk, 0.70, 95% CI, 0.51-0.96). This analysis suggests that there might be a reduction of about 25% in the risk of VAP with less frequent circuit changes.

The available evidence suggests that ventilator circuits do not need to be changed at frequent intervals. In fact, the evidence suggests that ventilator circuits do not need to be changed at any regular intervals. Adoption of this practice results in important health care cost savings, and might actually decrease the risk for VAP. ❖

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Transfusion Improves Outcome in Anemic Elderly Patients with Acute MI

ABSTRACT & COMMENTARY

Synopsis: For elderly patients with acute myocardial infarction who are anemic, transfusion appears to improve short-term mortality.

Source: Wu W-C, et al. Blood transfusion in elderly patients with acute myocardial infarction. *N Engl J Med*. 2001;345(17):1230-1236.

The cooperative cardiovascular project was a national program of the former Health Care

Financing Administration (now called the Centers for Medicare and Medicaid Services) that gathered data on 234,769 Medicare beneficiaries hospitalized with acute myocardial infarction (MI) in 1994 and 1995. Patients included in the cohort all had a primary discharge diagnosis of acute myocardial infarction. In the present study, Wu and associates examined this large cohort for any relationship between admission hematocrit and short-term mortality, and also for any effect of blood transfusion during hospitalization.

Wu et al excluded patients younger than 65, those whose diagnosis of acute MI could not be confirmed, those readmitted for another MI during the study period, and patients transferred into or out of the study hospitals during the index admission. Patients with no recorded admission hematocrit values, or values above the normal range, were excluded from analysis, as were those known to have metastatic cancer or other terminal illness, those who underwent cardiac surgery, those with gastrointestinal bleeding during the hospitalization, and patients meeting several other small exclusion criteria. The resulting cohort consisted of 78,974, or 34% of the original group.

A total of 34,275 of the study patients (43%) had hematocrit values lower than 39% on admission, and 3324 (4.2%) had values below 30%. Lower admission hematocrit values were associated with more frequent in-hospital events such as shock, heart failure, and death, and also with an increased length of hospital stay (*see Table*).

A total of 3680 patients (4.7%) received red cell transfusions during the hospitalization. The association between transfusion and outcomes varied according to the admission hematocrit value. Transfusion appeared to improve survival for patients who were definitely anemic: adjusted odds ratios for 30-day mortality among patients who received transfusions were 0.22 (95% confidence interval, 0.11-0.45) for admission hematocrits of 5 to 24%; 0.48 (95% CI, 0.34-0.69) for admission hematocrits of 24-27%; 0.60 (95% CI, 0.47-0.76) for values of 27-30%; and 0.69 (95% CI, 0.53-0.89) for admission hematocrits of 30-33%. However, transfusion was associated with an increased 30-day mortality for those with admission hematocrits above 36% (adjusted odds ratio, 1.13 to 1.46).

COMMENT BY DAVID J. PIERSON, MD

This study found that there was a high prevalence of anemia among elderly patients admitted with acute MI, and that anemic patients had higher 30-day mortality rates than nonanemic patients. Importantly, it also found that blood transfusion reduced this short-term mortality rate, in proportion to the degree of initial anemia. That is, in the large cohort used as a database, transfusion improved survival among patients with admission hematocrit values of 30% or lower, and may have been effective in lowering mortality in patients with hematocrits as high as 33%.

In order to really prove a cause-and-effect relationship here, a randomized trial would have to be done in which half of all anemic elderly MI patients received blood transfusions and the other half did not, using strict criteria and making all other aspects of management the same. It is unlikely that such a controlled trial will be done. However, because of the size of the study population and the robust methods used, the present study's findings should probably be taken seriously.

As pointed out in the editorial accompanying this study, the mortality rate among patients with admission hematocrit values of 27% or lower who did not receive transfusions approached 50%, and was nearly 3 times the mortality rate among patients with admission hematocrits over 39%. Transfusion was infrequently given to the patients in this study, even when they had substantial anemia. Only 24% of the patients whose admission hematocrits were 33% or lower received transfusions. If there really is a cause-and-effect relationship here, administering transfusions to all the anemic patients in this study would have saved a substantial number of lives.

Table

Outcomes of Acute MI in Elderly Patients as a Function of Admission Hematocrit*

Hematocrit (%)	5-24	24-27	27-30	30-33	33-36	36-39	39-48
Number of patients	380	838	2106	4848	9885	16,218	44,699
Shock (%)	15.0	10.3	10.9	9.5	8.6	7.5	6.2
Heart failure (%)	61.1	63.0	63.0	58.3	51.6	45.1	40.5
30-day mortality (%)	38.7	35.2	35.9	30.0	25.6	20.9	17.2
Length of stay (days)	9.9	10.6	10.0	9.6	9.1	8.6	8.3

* all trends statistically significant; $P < 0.001$

A lot of attention has been focused on transfusion practices in the ICU, and most of it has come with the message that we give too many transfusions, not too few. A multicenter, prospective, randomized controlled trial of transfusion thresholds in critically ill patients recently showed that the use of a lower cut-off (a hemoglobin concentration of 7.0 rather than 10.0 g/dL) was clinically safe.[1] An exception appears to be acute MI. Follow-up analysis of the data from the same study showed that there was a trend toward a higher mortality among 257 patients in a subgroup with ischemic heart disease.[2] Thus, patients with acute MI seem to be an important exception to the new transfusion rules being implemented in ICUs everywhere. If a patient admitted with an acute MI has a hematocrit level of 33% or less on admission, the risks and costs of transfusion would seem to be outweighed by the potential gain in reduced complications, length of stay, and short-term mortality. ❖

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Decreasing Antibiotic Misuse: Taking a Cue from the Pharmaceutical Reps

ABSTRACT & COMMENTARY

Synopsis: A one-on-one educational interaction targeted at reducing inappropriate antibiotic prescription led to a 41% reduction in such prescription in this randomized controlled trial in a major teaching hospital.

Source: Solomon DH, et al. Academic detailing to improve use of broad-spectrum antibiotics at an academic medical center. *Arch Intern Med.* 2001;161: 1897-1902.

Numerous studies have demonstrated that antibiotic misuse is both common and exceedingly costly. In hospitalized patients, it leads to unnecessary adverse effects and increased costs, and fuels the raging fire of emerging antibiotic resistance among common bacterial species. This study from the Divisions of Pharmacoepidemiology, Pharmacoeconomics, and Infectious Diseases at Brigham and Women's Hospital in Boston explored a novel means for reducing this inappropriate antibiotic usage: one-on-one, patient-specific communication with ordering physicians, or "antibiotic detailing." In carrying out this innovative investigation, Solomon and associates adopted a familiar strategy used by pharmaceutical representatives, using detailing not to promote sales of a particular drug but to bring antibiotic prescription more in line with accepted guidelines.

In Solomon et al's 700-bed teaching hospital, the medical service (receiving one-third of all admissions) is made up of 4-person teams, each consisting of an attending physician, a senior resident, and 2 interns. During an 18-week study period and using a blocked randomization design, half of the teams were assigned to the intervention and the other half served as controls. Solomon et al selected levofloxacin and ceftazadime as the target drugs, and used the hospital's computerized pharmacy records to track all orders for their use by the interns and residents on the teams. Strict definitions of appropriate and inappropriate prescription of these drugs were applied, consistent with current guidelines, and all inappropriate (unnecessary) orders were flagged for review.

The interns and residents on the teams randomized to receive the study intervention underwent one-on-one educational academic detailing each time an inappropriate order for levofloxacin or ceftazidime was received, delivered by 3 clinician-educators, 2 infectious diseases physicians, and 1 clinical pharmacist. The detailers presented standardized materials to the intern or resident interactively in a case-relevant, concise manner, stressing microbiologic data, local resistance patterns, and the clinical literature. They also provided copies of the guidelines and suggested alternative antibiotic regimens to the one ordered. House staff teams were unaware that their ordering patterns were being studied.

During the 4-week baseline period before randomization and throughout the 18-week study period, there were more than 4500 patients admitted to the medicine services at the study hospital. Patients and baseline antibiotic prescription patterns during the baseline period were similar for intervention and control teams. During the study period, 490 patients were prescribed levofloxacin or ceftazidime. After exclusions according to pre-established criteria, 260 patients received 278 unnecessary prescriptions for the study antibiotics. The number of days of unnecessary antibiotic use was 37% lower for the intervention services than for the controls ($P < 0.001$). In multivariate analyses that controlled for baseline prescribing and 2-week study interval, the rate of unnecessary use of the 2 target antibiotics was reduced by 41% on the intervention services as compared with the controls (95% confidence interval, 44%-

78%; $P < 0.001$). There were no significant differences in length of stay, transfers to the ICU, readmission rates, or in-hospital deaths.

COMMENT BY DAVID J. PIERSON, MD

As Solomon et al point out, about one third of all patients admitted to a hospital receive 1 or more antibiotics, and several studies indicate that at least half of all antibiotic orders are either unnecessary, poorly chosen, or incorrectly dosed. In one study of vancomycin use in a large teaching hospital, 70% of the orders for that drug during a 2-month period were judged inappropriate, and the rates of inappropriate usage on the medical and surgical services were the same.[1] These observations mean that any measure that decreased antibiotic misuse would have the potential both to improve patient care and to save the health care system a great deal of money, since antibiotics account for a large proportion of overall drug expenditures.

The strategy used by Solomon et al for attacking the problem of inappropriate antibiotic usage is well known to every physician. Pharmaceutical companies know that one-on-one, personal contact that includes the imparting of a take-home message, typically sweetened by the presentation of free food or a gift to cast the interaction in a positive light, is highly effective in modifying physician behavior. That is why they each spend as much as $5000 annually on marketing for each target physician, a substantial amount of it on one-on-one physician detailing. The marketing practices of the pharmaceutical industry,[2] and specifically the subject of detailing directed to housestaff at teaching hospitals,[3] have been the subject of considerable discussion lately, although this important topic is beyond the scope of the present comment.

Several aspects of this study potentially limit its applicability to routine clinical practice in the ICU and elsewhere. Although the techniques used by Solomon et al to approach and educate target physicians have been well described[4] and used in a variety of settings,[5] they tend to be labor intensive and expensive to implement. In the present study the estimated annual cost of academic detailing to the target physician population was $21,750, in an institution in which highly experienced and motivated personnel were already in place. Transplantation of Solomon et al's system to a community hospital would take a fair amount of initiative and effort, and it is unclear whether practicing physicians would respond to the intervention the same way as the interns and residents did in this study.

Nonetheless, the central messages of the study should be emphasized: inappropriate antibiotic prescription is widespread, has a number of important negative effects, and can be decreased through the use of clinician-targeted educational interventions. How to bring the latter about amidst the complexities and market forces of current practice is a challenge that deserves a widespread and concerted response. ❖

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Special Feature

Air Embolism in Patients with Central Venous Catheters

By Uday Nanavaty, MD

Central venous catheters (cvc) are commonly inserted in patients admitted to the ICU. One of the complications that develop in patients with CVCs is air embolism. This form of embolic phenomenon can be noted during insertion of catheter, when the catheter is in place, and also after the removal of the catheter. It is obviously difficult to have an estimate of the incidence of this complication—venous air embolism (VAE). However, it is important to recognize it, as it can be fatal if massive amounts of air enter the circulation rapidly. On the other hand, its prompt recognition can lead to successful therapy that can be life saving. Of note, a variety of surgical procedures are complicated by development of VAE, but the clinical manifestations are the same and range from no manifestations at all to cardiac arrest. Systemic air embolism beyond the pulmonary circulation and into the systemic arterial circulation can develop even if the patient does not have a patent foramen ovale and should be suspected in appropriate clinical settings.

Pathogenesis of Venous Air Embolism

Three conditions are required for air embolism to develop around CVCs.

1. *A direct communication* must exist between the atmospheric air and the venous circulation. This does not necessarily mean that there has to be an open communication as when one of the lumens is uncapped or when a syringe with some air in it is used for administration of medications inadvertently. A potential for such communication often exists when a catheter is removed after several days of use. Similarly, it has been noted that VAE can develop when air gains entry around a catheter if a large bore catheter (for example, the sheath of a PA catheter) is replaced over a wire with a smaller gauge catheter.

2. *A gradient of pressure* should exist between the entry site for air and the heart. Air travels from higher to lower pressure, especially if gravity favors the flow. This is one of the reasons why patients are placed in the Trendelenburg (head down) position during insertion and removal of CVC, so that the air would have to travel against gravity or a pressure gradient in order to enter the central circulation. Such pressure gradients (negative pressures in the thorax compared to entry site) are often formed when a patient has a violent cough (as it is preceded by a deep breath) or a sudden change in posture with sudden but dramatic changes in intra-thoracic pressure unfortunately favoring air entry into the circulation.

3. *A large amount of air* must enter at a relatively rapid rate to form big enough emboli to manifest clinically. Although it is hard to measure the exact amounts of air that enter patients, based on animal studies it is estimated that between 50 and 500 mL of air entering the circulation rapidly can be fatal in human beings. A 14-gauge catheter can introduce about 100 mL/sec of air with a 5 cm H_2O pressure gradient.

If a large amount of air enters the circulation rapidly, it can form a large bubble embolus and can occlude the pulmonary outflow tract, resulting in cardiac arrest. When air enters the pulmonary circulation, with constant motion of the heart and blood flow, it often breaks into smaller bubbles. The miniscule amount of CO_2 in air is rapidly dissolved in the blood. Oxygen is dissolved rather slowly, and nitrogen in air is almost insoluble, accounting for most of the bubbles in the circulation.

Platelets and other cells are activated at the sites of obstruction of the circulation and on the surfaces of smaller bubbles, and result in the release of inflammatory products. This inflammatory state often results in pulmonary edema. It is thought that increased pulmonary arterial pressure from obstruction by air bubbles and pulmonary vasoconstriction by inflammatory cytokines and prostaglandins also contributes to edema formation. The platelet products are also thought to result in increases in airway pressures and clinical wheezing, similar to the wheezing seen in venous thromboembolism. Air bubbles can cross pulmonary capillaries, or larger bubbles can cross at a patent foramen ovale or an arteriovenous malformation, and result in systemic manifestations ranging from cardiac dysrrhythmias and acute myocardial infarction to various neurological phenomena.

Clinical Features of Venous Air Embolism

The development of VAE related to CVC may be silent and of no clinical significance in the mildest form. Often, patients are described to have cough or deep breathing due to respiratory distress prior to development of VAE. A hissing sound of a large amount of air entry has been described in case reports. Numerous cases have been described where patients complain of dyspnea and an inability to catch their breath. With larger air emboli, hypoxia, cyanosis and tachycardia are noted. If the air embolism is massive, the patient may develop cardiorespiratory arrest. If circulation is somewhat maintained, sudden shock with signs of increased right-sided pressures in the form of elevated central venous pressures may develop. A “mill-wheel” murmur, due to churning of air inside the heart, has been described. Patients have been described who developed symptoms or signs of acute cardiac ischemia and infarction. Further systemic manifestations in the form of neurological changes are also known to develop. Depending on the circulatory involvement, any form of organ injury can be seen.

After acute onset, in mild cases, symptoms resolve quickly and this may be the only clue to the fact that the embolic manifestations were due to air. Rapid resolution of acute embolic events without therapy and without any evidence of thrombosis is often characteristic of air embolism. A large number of patients with moderate to massive air embolism develop pulmonary edema that typically resolves in 48 to 72 hours. Although the presentation of VAE can be dramatic and life threatening, rapid diagnosis and appropriate treatment often results in complete recovery. In most of the recently described cases as well as from personal observation, the diagnosis can be obtained by echocardiography. This is true especially in the operating room. Demonstration of air bubbles in central veins or major arteries or in the cardiac chambers is diagnostic. A rapid drop in end-tidal CO_2 is another sign of this embolic phenomenon, and in appropriate settings it can be diagnostic.

Treatment

Acute Massive VAE. When VAE is suspected as the cause of cardiac arrest or acute cardio-respiratory compromise, the patient should be immediately placed in the left lateral decubitus and Trendelenburg positions. This patient position makes the right ventricle the highest cardiac structure. Air, being lighter than blood, moves to the top of the right ventricle and is described to relieve the right ventricular outflow tract and may result in re-establishment of circulation. Further, if the diagnosis is made with echocardiogram immediately or is strongly suspected, air can be aspirated through the distal port of the CVC as well. Also, if an obvious source of air entry is found, appropriate measures should be taken to prevent further air entry into the circulation. Once the circulation is established general treatment strategies are used. In patients with cardiorespiratory arrest, appropriate advanced cardiac life support measures have to be taken.

General Measures

Oxygen. Even if patients are not hypoxemic, 100% oxygen therapy is recommended in patients with VAE. Dissolved oxygen can perhaps result in oxygenation of areas where blood flow is diminished due to obstruction by an air bubble. Also, oxygen can directly be exchanged for small amounts of nitrogen resulting in decrease in size and increase in surface tension on the air bubble that may result in faster resolution of air embolism.

Circulatory Support. If the patient remains hypotensive, infusion of saline should be considered. It is postulated that a drop in hematocrit due to fluids would be associated with decrease in viscosity of blood and that decreased viscosity may be favorable when there is micro-circulatory obstruction.

Hyperbaric Oxygen Therapy. In severely hypoxic patients or in patients with severe clinical manifestations, hyperbaric oxygen therapy can be considered once stable hemodynamics are achieved. Increasing atmospheric pressure directly reduces the size of the air bubble and results in break down of larger bubbles that obstruct vasculature. Also, significantly larger amounts of dissolved oxygen become available both for exchange with the air bubbles and also for oxygen delivery to areas where hemoglobin inside the red blood cell can not reach but plasma can diffuse. An arterial PO_2 of > 1000 mm Hg can be achieved under hyperbaric conditions, making the dissolved oxygen a significant contributor to overall oxygen transport.

Controversial Therapies. Heparin, lidocaine and high-dose corticosteroids have been used in the past to treat VAE, especially if there are CNS manifestations. However, their role remains unproven and controversial at best.

Prevention of VAE Related to CVC

The use of the Trendelenburg position is strongly recommended both during insertion and removal of CVCs from either jugular or subclavian locations. When a large bore catheter is exchanged with small-bore catheter, care should be taken to occlude the orifice at skin level as best as possible. When a CVC is removed, an occlusive dressing should be applied at the site of the catheter. If patients are discharged with CVC, due care should be explained especially highlighting the need to keep the catheter capped at all times. Although these preventive measures seem obvious, a recent nursing survey found that a large number of CVCs were removed when patients were not in Trendelenburg position, and sometimes when patients were in sitting position.

Summary

In summary, VAE related to CVC is largely a preventable complication that can present with varied clinical manifestations. Prompt recognition and appropriate treatment including oxygen therapy and hyperbaric oxygen therapy may result in complete recovery. ❖

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CME/CE Questions

9. What is the relationship between the frequency of ventilator circuit changes and the risk of ventilator-associated pneumonia?

a. Less frequent circuit changes increases the risk of VAP in medical patients, but not for surgical patients.
b. Less frequent circuit changes increases the risk of VAP in adult patients, but not for pediatric patients
c. Less frequent ventilator circuit changes do not increase the risk of VAP, and might actually decrease the risk of VAP
d. Less frequent ventilator circuit changes increase the risk of VAP, and therefore circuits should be changed at regular intervals.

e. Ventilator circuits do not need to be changed at regular intervals to control VAP rates, but inline suction catheters should be changed daily.

10. Changing ventilator circuits every 7 days instead of every 2 days:

a. increases overall lengths of ICU stays.
b. actually increases costs.
c. increases the rate of ventilator-associated pneumonia.
d. All of the above
e. None of the above

11. Transfusion of elderly patients with acute myocardial infarction was associated with a reduced 30-day mortality if their admission hematocrit values were equal to or less than which of the following?

a. 24%
b. 27%
c. 30%
d. 33%
e. 36%

12. The mortality rate among elderly patients with acute myocardial infarction whose admission hematocrit levels were 27% or less and who did not receive transfusion was approximately which of the following?

a. 20%
b. 30%
c. 40%
d. 50%
e. 60%

13. What proportion of all patients admitted to a hospital receive antibiotics?

a. 10%
b. 21%
c. 33%
d. 45%
e. 60%

14. Using a one-on-one educational intervention ("academic detailing"), the inappropriate use of levofloxacin and ceftazidime was reduced by:

a. 5%.
b. 17%.
c. 29%.
d. 41%.
e. 55%

15. A substantial reduction in inappropriate antibiotic usage by interns and residents can be achieved by:

a. providing free reprints of relevant research studies as they are published.
b. offering free lunch and promotional materials by pharmaceutical representatives.
c. providing one-on-one educational interactions ("academic detailing") when antibiotics are prescribed inappropriately.
d. giving them free subscriptions to infectious disease journals.
e. attendance at grand rounds and other conferences addressing this topic.

16. A 50 year-old man became unresponsive and developed signs of right sided failure after having a bout of coughing as he was moving from his bed to a wheelchair. A central venous catheter was just removed from the right subclavian location after 7 days of use. You suspect venous air embolism and occlude the site of previous central venous catheter. All the following diagnostic or therapeutic measures are appropriate *except*:

a. Place the patient in left lateral decubitus position with Trendelenburg position to relieve right ventricular outflow tract obstruction.
b. Establish airway, breathing, and circulation.
c. Give IV fluids, 100% oxygen, and other supportive measures.
d. Order an echocardiogram to see if there is air present in right ventricle that can be aspirated or to confirm the diagnosis.
e. Start Heparin 5000 U IV bolus and 17U/kg/h infusion as patients with any form of pulmonary embolism should be anticoagulated.

CME/CE Objectives

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

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

Attention Readers . . .

American Health Consultants is happy to announce that we are opening up our *Primary Care Reports* author process to our readers. A biweekly newsletter with approximately 5000 readers, each issue is a fully referenced, peer-reviewed monograph.

Monographs range from 25-35 Microsoft Word document, double-spaced pages. Each article is thoroughly peer reviewed by colleagues and physicians specializing in the topic being covered. Once the idea for an article has been approved, deadlines and other details will be arranged. Authors will be compensated upon publication.

As always, we are eager to hear from our readers about topics they would like to see covered in future issues. Readers who have ideas or proposals for future single-topic monographs can contact Managing Editor Robin Mason at (404) 262-5517 or (800) 688-2421 or by e-mail at robin.mason@ahcpub.com.

We look forward to hearing from you. ❖

In Future Issues: Protein C and Survival from Sepsis?

CRITICAL CARE Plus

EXPANDING YOUR FOCUS IN INTENSIVE CARE

Applying Strategic Planning to End-of-Life Decisions

Designed for business, computer models now aid critical care

By Julie Crawshaw, CRC Plus Editor

Question: what do managing investment portfolios, designing video games, and end-of-life issues have in common?

Answer: They can all use the same computer-based advanced technology to make sound decisions, high-tech tools that take users through the same kind of decision-making process used by corporate executives.

A joint venture undertaken by Michigan State University, the Henry Ford Health System, the Robert Wood Johnson Foundation, and the Michigan Department of Community Health has produced an interactive CD-ROM that aids patients and families with the practical, emotional, spiritual, and medical decisions critical illnesses bring.

And Aliah, Inc., a Pittsburgh-based company that offers software, training, and e-Decision applications used in business since 1994, has come out with a computer program called LifePath which it says helps users rank the things most important to them about their own deaths or those of family members.

Advocates for improving the quality of end-of-life care say that programs like LifePath and CD-ROMs like Completing a Life will make more people aware of the need to plan for their medical, personal, and financial needs, thereby making a big positive difference in outcomes.

"Completing a Life helps people facing end-of-life journeys," says Karen Ogle, MD, who worked on the project. Ogle, who directs the Palliative Care and Research Program at Michigan State University, says the new technology allows people to plan for the future they want and increase their sense of control in situations that usually cause feelings of powerlessness.

CD-ROM Offers Dual Benefits for Critical Care Medicine

Ogle sees two ways that Completing a Life can benefit critical care medicine. The first is preventive, because making sound end-of-life decisions can help people avoid being in critical care. Though the CD might not be something a physician would hand to an ICU patient, Ogle says that giving it to a stabilized patient going home or entering an extended care facility could work very well. "Critical care physicians could present it to these patients as an important tool for planning the future of their illness and determining what they want to do with the rest of life," Ogle says. "This might help them review their goals and look at strategies for meeting them."

Ogle points out that even when the patient is too ill to use the resource, the family can certainly benefit from it. "Many patients in critical care are able to communicate with their families and thereby use the resource second-hand," Ogle says. She points out that many patients have a terminal prognosis that hasn't been sufficiently discussed to help them make the kinds of decisions that would keep them out of the critical care unit. "When we look at surveys of the public at large, an overwhelming majority of people don't want heroic measures when there's no significant chance of that leading to a longer life with quality," she says.

Completing a Life is Divided into Three Parts:

- **Taking Charge.** This includes staying active in decisions about health care, family, and everyday living;

- **Finding Comfort.** This involves easing pain and suffering, and living with dignity at this time of life;
- **Reaching Closure.** This includes coming to terms with the past, present and future, and exploring the possibilities for spiritual growth

Angela Lambing, MSN, RN, nurse practitioner at Henry Ford Hospital in Detroit and project manager for Completing a Life, observes that communication skills are noticeably absent in current curricula for interns and residents. Lambing says that Completing a Life, which is available by order or high-speed Internet connection, will be sent to key medical and nursing schools, hospice organizations, oncology nurses, and palliative care physicians.

"Every doctor in our health care system will get a copy of this," Lambing says. "Our goal is to have them recognize they can learn from it and also use it as a communication tool with patients. It's not a replacement communication, it's a bridge."

The product works with a computer's web browser and contains more than 100 separate topic pages linked by navigation tools. The material covers a wide range of concerns, from obtaining good pain relief and family communication to writing advance directives, and finding spiritual peace.

Completing a Life also has a section on different diseases and where to get resource materials about them. "We have the ability to make people live longer," Ogle notes. "What we've not been doing is making that a worthwhile experience." During tests of the first version, a breast cancer patient in her 30s asked if using the CD would help her find the right words in talking about death with her kids. The production team hadn't focused on terminal patients with young children, a need they quickly filled.

The first section explores financial, funeral, and medical planning topics such as creating an advance directive, finding a doctor with whom the patient is comfortable, and asking the right questions. Completing a Life features videos of nine patients who offer personal testimonies that can act as a virtual support group. It also describes what families can expect during the last hours of dying. "Users can pick and choose the topics important to them in the privacy of their own homes," Lambing says.

Ogle says her group plans to evaluate the CD's use, initially focusing on patients with cancer diagnoses. There's been some public feedback already, in the form of more than 100 e-mail requests received for the CD in the wake of a *New York Times* article.

Computer Programs Aid Personal Decisions

Aliah's LifePath is one of the Personal Decision Process (PDP) programs the company designed based on business strategies. However, whereas strategic thinking traditionally places much weight on the rational part of decision-making, PDP programs factor emotion, intuition, and opinions into the mix via a pair of templates that can be used together or alone. One template helps the individual to assess satisfaction with quality of life criteria and make choices based on that assessment. The other helps the user set goals and identify needed improvements. Using the templates together, an individual can better assure that his or her goals are improving his or her quality of life.

The quality-of-life assessment tool can be used through web applications, software run on PCs, a network, or through database integration.

And finally, Leslie J. Bricker, MD, oncologist and palliative medicine specialist at the Henry Ford Health System in Detroit, has created another high-tech tool with critical care applications. Bricker devised a quick computer access route for medical notes and end-of-life documents from patients' files to help doctors avoid life-prolonging procedures against patients' wishes. Potential users can test-drive Aliah's on-line decision technology by clicking on the link for personal decision-making examples.

For more information on Completing a Life call (313) 714-2455 or visit the Internet site: www.completingalife.msu.edu. For more information on LifePath, call (412) 621-4500 or visit www.aliah.com. ❖

Shockingly Good Idea?

Some experts want increased AED availability

Two studies on automated external defibrillators (AEDs) indicate that casinos and airlines may have a better shot at saving lives in cardiac arrest cases than many hospitals do.[1,2] Yet even though the American Heart Association and others have supported AED use by nonmedical personnel, some say the devices should be under physician control.

Mickey S. Eisenberg, MD, PhD, director of emergency services at the University of Washington/Seattle, says AEDs should be an over-the-counter item available to any consumer. "The argument has to do with the safety and simplicity of the device," Eisenberg says. "Anyone can learn how to use it, literally in a matter of minutes." Eisenberg adds that the device coaches the user by providing prompts on what to do next. "We know that about 75% of all cardiac arrests happen at

home," Eisenberg says. "The logical way to save more lives is to turn AEDs into a consumer item."

Eisenberg is certainly no stranger to out-of-hospital AED use. In 1980, along with several colleagues, he demonstrated that patients who were defibrillated by EMTs enjoyed significantly higher rates of survival to hospital discharge than patients who only got CPR and rapid transport to a hospital.

Survival rate figures from the casino and airline studies referenced above appear to further support making AEDs as a consumer item.

When AEDs were used at a casino, 56 of 105 patients whose initial cardiac rhythm was ventricular fibrillation survived to discharge from the hospital. The survival rate was 74% for those who received their first defibrillation no later than three minutes after a witnessed collapse and 49% for those who received their first defibrillation after more than three minutes. For 86% of the 90 patients whose collapse was witnessed, the clinically relevant time intervals were a mean (± SD) of 3.5 ± 2.9 minutes from collapse to attachment of the defibrillator, 4.4 ± 2.9 minutes from collapse to the delivery of the first defibrillation shock, and 9.8 ± 4.3 minutes from collapse to the arrival of the paramedics.[1]

Flight attendants for a major US airline were trained on AEDs in 1997. They used devices when passengers lost consciousness, pulse, or stopped breathing. The AED was also used as a monitor for other medical emergencies, usually at the direction of a physician passenger. Two arrhythmia specialists analyzed electrocardiograms obtained during AED use between June 1, 1997, and July 15, 1999, found the survival-to-discharge from the hospital rate following AED shock was 40%. No complications arose from use of the automated external defibrillator as a monitor in conscious passengers. Researchers concluded that complications are unlikely AEDs are used as a monitor in the absence of ventricular fibrillation.[2]

New AED May Eliminate Some ICU Stays

Thomas Mattioni, MD, director of electrophysiology at Arizona Heart Institute in Phoenix, says his hospital uses an AED called Powerheart. Unlike paddle-activated hospital-administered AEDs, PowerHeart devices are actually worn by patients. Powerhearts use wires that run from adhesive pads placed on chest where paddles would go with in-hospital defibrillation to the defibrillator. Powerheart AEDs, also used extensively at Boston's Maimonides Hospital, detect signals through the pads, takes EKG's and continuously monitors patients, delivering shocks during arrhythmias that return the heart rate to normal. "It's like the implantable device in that once it's attached it's fully automatic, monitors the patient, detects when something has gone wrong and deliver the appropriate therapy without human intervention," Mattioni says, "Except that the adhesive pads need to be changed every 24 hours."

Mattioni says Powerheart is the only device that allows for fully automatic therapy. Mattioni says his facility has 20 PowerHeart AED devices and 58 beds. Half of the patients attached to the Powerheart survived. Only 20% of those not attached to the devices survived. "We can't make any valid statements about the efficacy of the Powerheart based on those small numbers, but I think there's certainly a trend there," Mattioni says.

Mattioni points out that the faster you can shock a patient following cardiac arrest, the faster they get back to normal. Powerhearts ensure that the patient will receive a shock at a pre-programmed time—typically after 30-60 seconds of arrhythmia—thus beating the usual hospitals response times of 4-5 minutes by a wide margin. "We don't do as good a job of resuscitating people following cardiac arrest as some casinos do," Mattioni says, observing that casino response times for the majority of patients fell within three minutes. "That's the whole key to this technology, decreasing the amount of time the patient is in ventricular arrhythmias and thus decreasing long-term neurological or cardiac damage associated with that arrest," Mattioni says. "Our goal is to bring the survival to the highest rate we can."

Mattioni observes that a patient in a telemetry unit who suffers arrest is shocked and resuscitated. A patient who survives is intubated, hooked up to a ventilator, and taken to the intensive care unit. Those patients are frequently given implantable defibrillators.

Mattioni says that with Powerheart AEDs, patients don't need to be intubated, have their chest compressed or take special medications. "If you shock them very close to the time they lose consciousness, the patient not only doesn't remember getting the shock but don't have any long term brain damage, either, Mattioni says. "If properly applied, Powerheart stands to potentially eliminate post-resuscitation ICU stay."

Possible Access Drawbacks Cited

Not everyone thinks universal AED access is a great idea. Arthur Kellerman, MD, of the Department of Emergency Medicine at Emory University School of Medicine in Atlanta, says that "with rare exceptions, it is not even clear where public access AEDs should be placed because few locations are settings for more than 1 cardiac arrest per year.[4]

Kellerman acknowledges that AEDs are clearly efficacious for terminating ventricular fibrillation or ven-

tricular tachycardia when swiftly applied. But he argues that alone does not justify making AEDs readily available before they are shown to be a cost-effective strategy for reducing mortality from out-of-hospital cardiac arrest.[4] Kellerman also points out that prices quoted for AEDs rarely include initial and refresher training costs, or costs for electrodes, extra batteries, maintenance, and eventual replacement.

Kellerman writes that "the fact that some people can afford to purchase a medical device that delivers a powerful shock does not absolve physicians of the responsibility to control access to it. More important, there is no evidence that placing an AED in the home of a patient with heart disease is better than teaching family members to immediately call 911 and begin CPR. While there is little doubt that authorizing over-the-counter sales of AEDs would produce a financial windfall for the manufacturers of these devices, it is less clear that the public would benefit. Given the choice of spending between $250 and $1500 to purchase an AED for the home or spending a comparable amount of money on a bicycle, a smoking cessation program, a health club membership, or treatment of hypertension, most people would be better served by choosing one of the latter options for themselves or a loved one." ❖

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Readers are Invited. . .

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