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## Unplanned Extubation: Insight from Three New Studies

ABSTRACTS & COMMENTARY

Three recent prospective studies from europe shed light on the problem of unplanned extubation in patients in the ICU. In addition to summarizing their findings, considering the three studies together provides further insight into this frequent and important clinical issue.

The frequency of unplanned extubations (UEX) among intubated ICU patients in the study of Boulain et al was 46 of 426 or 10.8%. At the time of UEX, 61% of the patients were agitated. Of the 46 instances of UEX, 28 (61%) required reintubation. Factors contributing to UEX were chronic respiratory failure, poor endotracheal tube fixation, orotracheal intubation, and lack of intravenous sedation.

This study was a prospective, multicenter, observational study performed in 11 ICUs in 11 French hospitals. Data including clinical status, sedation, approach to mechanical ventilation, nurse-to-patient ratio, the need for reintubation after UEX, and complications of extubation were recorded on each mechanically ventilated patient in every participating ICU during a two-month period. A total of 426 patients were ventilated, and of these, 46 (10.8%) had at least one UEX. Five patients had two UEXs and two patients had four UEXs, for a total of 57 episodes of UEX, at a rate of 1.59 UEX per 100 intubated days.

Fifty-five of the UEXs were considered self-extubations. Overall, 10 occurred during nursing procedures and one patient died as a direct result of the UEX. Multivariate analysis identified four factors contributing to UEX: chronic respiratory failure, poor endotracheal tube fixation, orotracheal intubation, and lack of intravenous sedation. There were no differences in nosocomial pneumonia rate or mortality between patients with UEX and those who did not self-extubate. Of the patients with UEX, 39% did not require reintubation.

In the study of Betbesé et al, the frequency of UEX in 750 mechanically ventilated patients in two Spanish hospitals was 7.3%. Deliberate patient extubation occurred 78% of the time; 56% of the time patients were in the process of weaning, and 37% of the patients who deliberately self-extubated did not require reintubation.

Volume 6 • Number 11 • February 1999 • Pages 81-88

## INSIDE

This prospective evaluation of the frequency of UEX was conducted in two ICUs in a single hospital in Barcelona, Spain. Data on clinical presentation, approach to ventilation, size of endotracheal tube, level of sedation, and complications were gathered on 750 ventilated patients over a 32-month period. During this time 55 patients (7.3%) self-extubated, for a total of 59 UEX. Of the 59 UEX, 78% were judged to have been deliberate on the part of the patient and 22% were considered accidental. A total of 32 patients (54%) did not require reintubation after UEX. All patients in both ICUs were orally intubated; no patient was nasally intubated during the study period.

Twenty-seven (46%) UEXs occurred during full ventilatory support. In the remaining UEXs, patients were in the process of weaning. Of the 46 patients who deliberately self-extubated, 37% required reintubation, while 77% of the accidental UEXs (10/13) required reintubation. In addition, only 16% (5/32) of patients who were weaning at the time of the UEX required reintubation, while 82% of the patients who had been receiving full ventilatory support required reintubation. No patient died as a result of an UEX. Multivariate analysis indicated that reintubation was more likely to be required after UEX the longer the duration of mechanical ventilation at the time of the UEX; weaning was associated with a lack of need for reintubation.

In the third study, by Chevron et al, the frequency of UEX in 414 mechanically ventilated patients in a single French hospital was 15.9% (66 instances). Deliberate self-extubation occurred in 87% of UEX.

This study was performed in a single French ICU over a 15-month period. During this time 414 patients were intubated and ventilated, of whom 66 (15.9%) extubated themselves. Of the total UEXs, 87% were considered deliberate patient self-extubations, with 13% considered accidental. UEX occurred more frequently in patients who were orally intubated, who were agitated, and had their hands restrained. At the time of the UEX 17 of the patients were in the process of weaning.

Patients who required reintubation (23) following a UEX had a Glasgow Coma Scale score of less than 11 and a $PaO_2/FIO_2$ ratio of less than 200 mm Hg, and were most commonly extubated accidentally. In contrast, patients who deliberately removed their endotracheal tubes had Glasgow Coma Scale scores of more than 11, $PaO_2/FIO_2$ ratios greater than 200 mm Hg, and only one of them was reintubated. Only one of the patients who self-extubated died as a direct result of the UEX. (Boulain T, et al. *Am J Respir Crit Care Med* 1998;157:1131-1137; Betbesé A-J, et al. *Crit Care Med* 1998;26:1180-1186; Chevron V, et al. *Crit Care Med* 1998;26:1049-1053.)

## COMMENT BY ROBERT M. KACMAREK, PhD, RRT

These three studies, when taken in total, identify a number of important issues regarding patients who are most likely to extubate themselves in the ICU. Considered in total, of 1590 ventilated patients in these studies, 167 (10.5%) had an unexpected extubation. What is more interesting is that 53% (89 patients) did not require reintubation. In the one study that provided data on the number of patients participating in weaning (the study of Betbesé and colleagues), the reintubation rate following an UEX was only 15.6%. This emphasizes problems in identifying readiness for ventilator discontinuation and extubation. It seems reasonable to state that those patients who did not require reintubation should already have been weaned and extubated.

Patients in all three studies who were agitated, regardless of the reason, had the greatest likelihood for self-extubation. In two of these studies the authors identify oral endotracheal intubation as a risk factor for UEX. However, the Betbesé study, which reported on the largest number of ventilated patients, had the lowest rate of UEX (7.3% vs 10.8% and 15.9%), and only used oral intubation. More important, as identified by Boulain and associates, was the method used to secure the endotracheal tube. Boulain et al indicated that the least likely

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securing method to be associated with UEX was the use of a cloth tie that went around the back of the patient's neck. This was the same method that was used by Betbesé et al in all patients. However, Chevron and colleagues, who reported the highest UEX rate, used this same method in orally intubated patients.

The likelihood of UEX in all these studies was associated with agitation and insufficient sedation, as well as with inappropriate prolongation of the process of mechanical ventilation. Both of these factors indicate the need for more rapid identification of patient readiness to wean and be extubated following ventilatory support. As shown by the experience of Chevron et al and Betbesé et al, patients who are in the process of weaning, especially those with Glasgow Coma Scale scores higher than 11 and $PaO_2/FIO_2$ ratios greater than 200 mm Hg who deliberately extubate themselves, most likely will not require reintubation. In patients who fit this description, a trial of spontaneous breathing should occur before reintubation is considered. More important, institutions with a high percentage of patients who extubate themselves during weaning and who do not require reintubation should review their approach to both weaning and extubation. ❖

**The single factor that most commonly was associated with a lack of need for reintubation in the Boulain, Betbesé, and Chevron studies was:**

a. extubation that took place during the process of weaning.
b. nasotracheal intubation.
c. improper securing of endotracheal tube.
d. inadequate sedation.
e. none of the above

# Glutamine Reduces Infection in Trauma Patients

ABSTRACT & COMMENTARY

***Synopsis:*** *In patients with multiple trauma, glutamine-enriched total enteral feeding was associated with lower incidences of pneumonia, sepsis, and bacteremia than a balanced, isonitrogenous, and isocaloric enteral feeding regimen.*

**Source:** Houdijk AP, et al. *Lancet* 1998;352:772-776.

A total of 80 patients with multiple trauma were randomly allocated to either glutamine-supplemented enteral feeding (52 g protein [30.5 g glutamine/100g protein], 165 g carbohydrate, 15 g fat, and 1000 kcal/L) or an isocaloric, isonitrogenous control feeding (3.5 g glutamine/100 g protein). Both feedings contained the same amount of arginine and other essential amino acids. Eligible patients had an Injury Severity Score (ISS) of more than 20, were between 16 and 65 years of age, and had an expected survival rate of more than 48 hours as estimated by both the Glasgow Coma Scale Score and ISS. The patients were assigned to feeding by the pharmacist using computer-generated randomization, and all participants were unaware of treatment allocation. Feeding was started within 48 hours of admission and was continuously given, aimed to reach 75% of the basal energy expenditure within 72 hours. The caloric requirement was estimated and adjusted by indirect calorimetry. No other form of nutrition was given. The enteral feeding lasted at least five days. The end points of the study were infectious morbidity during the first 15 days. The concentrations of glutamine, arginine, and soluble tumor necrosis factor (TNF) receptors p55 and p75 in the blood were determined on the appropriate days.

The incidences of pneumonia, bacteremia, and sepsis were significantly lower in the glutamine-supplemented group in comparison with the control group (17% vs 45%, 7% vs 42%, and 3% vs 26%, respectively). In the treated patients, plasma concentrations of arginine and glutamine became significantly higher on days 3-5, and serum concentrations of soluble TNF-receptor p55 and p75 became lower on days 4-7.

## COMMENT BY JUN TAKEZAWA, MD

Glutamine, structurally different from glutamic acid, has been called a "conditionally essential" amino acid, which cannot be sufficiently synthesized to meet the necessary requirements under a stressed state such as infection, trauma, or surgery. Under stress, skeletal muscles are catabolyzed, releasing amino acids, one-third of which consist of glutamine. When glutamine is given intravenously, this muscle catabolism is suppressed. In patients with multiple trauma, burns, and sepsis, the amount of glutamine in the skeletal muscle is decreased. Glutamine is also known as a respiratory fuel for mucosal cells in the intestine and colon. However, the most important roles are to multiplicate neutrophiles and to facilitate and assist in the killing of bacteria. These points comprise the background and rationale that glutamine may improve infectious mortality and morbidity in patients in a catabolic condition such as trauma.

Houdijk and colleagues conducted a well-designed randomized controlled trial (RCT) in the double-blinded fashion. The first RCT on glutamine-supplemented enteral feeding demonstrated improved six-month mortality in ICU patients (*Nutrition* 1997;13:295-302). This is the second RCT that has described the possible benefit of glutamine-supplemented enteral feeding in reducing

infectious morbidity, which hopefully will also be associated with improved final outcomes such as mortality and medical costs.

Houdijk et al were interested in intermediate outcomes such as infectious morbidity and biochemical parameters such as soluble TNF receptors, and did not describe final outcomes in the patients studied. The only information related to patient outcome presented in this paper was the median stay of the patients in both groups, which was found not to be significantly different. It is surprising that the significantly higher incidence of infectious episodes in the control group did not result in the longer hospital stay. Future investigators are encouraged to conduct another RCT focusing on the final outcomes such as mortality and medical cost, as well as length of ICU and hospital stays and infectious morbidity. Until the final conclusion is made, glutamine-enriched enteral feeding for posttraumatic patients cannot be recommended. ❖

**Glutamine feeding in trauma patients has been demonstrated to:**

a. decrease mortality, morbidity, and ICU costs.
b. decrease morbidity and ICU costs but not mortality.
c. decrease mortality and morbidity but not ICU costs.
d. decrease morbidity but not mortality or ICU costs.
e. None of the above

# Are Radial and Aortic Pressures the Same on Vasopressors?

ABSTRACT & COMMENTARY

***Synopsis:*** *Radial artery pressures are unreliable and should not be used to manage drug infusion in patients receiving high doses of vasopressors. A group of 14 septic patients receiving an average of 85 µg/min of norepinephrine demonstrated a systolic pressure gradient of 57 mm Hg and a mean pressure gradient of 15 mm Hg, with radial artery pressure significantly less than aortic pressure.*

**Source:** Dorman T, et al. *Crit Care Med* 1998 (10);26:1646-1649.

Suspecting a discrepancy between central and radial artery pressures, Dorman and colleagues studied 14 patients with septic shock who were receiving norepinephrine titrated to maintain a mean radial arterial blood pressure of at least 60 mm Hg. The study involved inserting a 30-cm, 16-gauge vascular catheter into the central aorta using the Seldinger technique from a femoral artery, and comparing simultaneous aortic and radial artery pressures. Nine men and five women averaging 57 years of age were studied. Septic shock was presumed present if the usual conditions were seen. Norepinephrine was begun if the mean radial arterial pressure was less than 60 mm Hg with a pulmonary artery wedge pressure greater than 12 mm Hg and a high cardiac output (average 7.1 L/min). After mean pressure was restored to 60 mm Hg or higher, the femoral catheter was inserted and aortic pressure measured. Using the same transducer and identical tubing, simultaneous determinations of systolic, diastolic, and mean pressures were then made.

The first recorded pressures obtained within 5 minutes of femoral line placement were averaged. (*See Table 1.*) The average dose of norepinephrine was 85.6 µg/min at the time of the measurement. All patients demonstrated a higher mean aortic than radial arterial pressure, while several had identical systolic pressures and one patient actually had a lower aortic diastolic pressure. Most patients had their radial artery catheter removed after the femoral line was placed. Two patients remained cannulated in both arteries over the several days while they were weaned from norepinephrine. In these two patients, the mean arterial gradient disappeared after the vasoconstrictor was discontinued.

**COMMENT BY CHARLES G. DURBIN, Jr., MD, FCCM**

Radial artery systolic pressure is normally higher and diastolic pressure lower than aortic pressure due to the effects of reflected and standing waves in the vascular tree. Hypertension, stiff vessels, and tachycardia increase these gradients. Mean arterial pressure, however, is unaffected by this wave phenomenon and radial and aortic mean pressures are usually close to each other. The reversed systolic pressure gradient and lower radial mean arterial pressure reported here have also been identified in patients during rewarming after cardiopulmonary bypass. In this circumstance it is thought to be due to extreme vasodilatation in the peripheral circulation, although the exact mechanism is not known.

**Table 1**

**Recorded Average Pressures**

| | Systolic Pressure mm Hg | Diastolic Pressure mm Hg | Mean Pressure mm Hg |
|---|---|---|---|
| **Aortic** | 143 | 60 | 81 |
| **Radial** | 86 | 55 | 66 |
| **Pressure Difference** | -57 | -5 | -15 |

Whatever the cause of this gradient, the clinical implications are clear: septic patients receiving high-dose norepinephrine should have their vasoactive drip titrated to *aortic* pressure rather than to the pressure measured in a radial or other peripheral artery. Patients in this study had the dose of norepinephrine rapidly reduced following aortic catheter insertion. Unanswered questions include: At what norepinephrine dose does the gradient become significant? Do other vasoconstrictive agents (i.e., phenylephrine, epinephrine) produce the same problem? Does the vasoconstrictor use gradient exist in other forms of shock? ❖

**Norepinephrine infusion in septic shock:**

a. reduces the incidence of renal failure.
b. improves gas exchange.
c. selectively improves adrenal blood flow.
d. makes radial pressures unreliable.
e. is associated with methemoglobinemia.

# Fluid Resuscitation in the Critically Ill: Crystalloid or Colloid?

ABSTRACT & COMMENTARY

***Synopsis:*** *In this meta-analysis of 37 prospective studies comparing crystalloid and colloid fluid infusion as resuscitation in critically ill patients with sepsis, trauma, or surgery, no differences in mortality were detected, either overall or in any subgroup of patients.*

**Source:** Schierhout G, et al. *BMJ* 1998;316:961-964.

This meta-analysis by schierhout and associates at the University College London Medical School examined the effect on mortality of fluid resuscitation using crystalloid or colloid solutions. Only prospective randomized controlled trials involving crystalloid vs. colloid solution administration in adult or pediatric patients with sepsis, trauma, surgery, or burns were considered for inclusion. Studies were excluded if the purpose of fluid resuscitation was preparation for surgery or if there were confounding variables. Data bases searched for qualifying studies included MEDLINE, EMBASE/Excerpta Medica, and the Cochrane Controlled Trials Register. In addition, Schierhout et al individually searched the bibliographies of trials and reviews and the proceedings of international congresses in an attempt to identify appropriate trials.

Schierhout et al identified 48 trials in their search, of which 37 met the inclusion criteria. In 1315 patients selected from 19 of the trials, no differences in mortality were found in relation to the type of resuscitation fluid used. Overall all-cause mortality rate in these 1315 patients was 18.7% for those resuscitated with crystalloid solutions as compared with 19.4% for those who received colloid solutions (relative risk = 1.19; 95% confidence interval = 0.98 - 1.45; P = 0.3). Subgroup analysis of only those trials in which allocation of the type of solution infused was concealed from the clinicians managing the patients yielded essentially the same results. Analysis of subgroups according to the type of injury or illness failed to bring out significant mortality differences in any group.

**COMMENT BY DAVID J. PIERSON, MD, FACP, FCCP**

Controversy continues both at the bedside and in the classroom as to whether colloid solutions such as albumin or dextrans are more effective than crystalloids (either isotonic or hypertonic) in restoring and maintaining circulating blood volume in critically ill patients. Although colloid solutions are substantially more expensive, their use continues to have strong advocates, and clinical practice varies both from institution to institution and within a given center. Schierhout et al's rigorous examination of data from a large number of studies failed to show a survival benefit for the use of colloids, either in aggregate or in patients in any of the examined subgroups.

If infusing colloid solutions, in the circumstances examined in this analysis, is better for patients than using crystalloids, the difference must surely be a small one. Schierhout et al were unable to show a survival benefit for colloid infusion in subgroups of patients with trauma, surgery, burns, or other injuries. This does not mean that colloid infusion might not be preferable to the use of crystalloids in certain categories of patients within these subgroups or in certain clinical settings that were not examined in this study. However, just which patients or settings those might be remains unknown at present, at least on the basis of results from prospective, randomized controlled clinical trials. Using crystalloid rather than colloid for fluid resuscitation in the ICU is clinically acceptable and costs less. ❖

**Resuscitation with colloid solution such as albumin or dextran instead of crystalloid such as normal saline is associated with improved overall mortality in which of the following circumstances?**

a. Burns
b. Trauma
c. Sepsis
d. Surgery
e. None of the above

Special Feature

# Update: Nosocomial Bacteremia in Critically Ill Patients

*By Francisco Baigorri, MD, PhD, and Jordi Vallés, MD*

Patients hospitalized in intensive care units (ICUs) are at high risk of developing bloodstream infections. The incidence rate of nosocomial bacteremia in the ICU ranges between 1.65 and 4.1 episodes per 100 admissions.[1-3] This incidence rate in ICU patients can be up to seven times higher than in general ward patients; in total, 30-45% of all episodes of nosocomial bacteremia occur in critically ill patients.

Moreover, despite important progress in antibiotic therapy and in ICU management of critically ill patients, the fatality rate of ICU patients with nosocomial bacteremia remains high.[1] However, few studies have adequately analyzed the infection in this selected population. This essay discusses some specific characteristics of bloodstream infections in ICU patients with reference to the leading sources of bacteremia, leading pathogens, and prognosis.

## Sources of Nosocomial Bacteremia in the ICU

The source of bloodstream infections in an ICU can be identified in almost 75% of all episodes of bacteremia.[1,3,4] The main sources of bloodstream infections in critically ill patients are catheter-related and lower respiratory tract infections. (*See Table 2.*)

**Table 2**

**Sources of Nosocomial Bacteremia in the ICU**

| Source of bacteremia | Author (Ref. #) | | |
|---|---|---|---|
| | Pittet (1) | Rello (4) | Vallés (3) |
| Lower respiratory tract | 28% | 10% | 17.5% |
| Intravenous catheter | 18% | 35% | 37% |
| Urinary tract | 5.4% | 3.6% | 6% |
| Surgical wound | 8% | 8% | 2.4% |
| Intra-abdominal infection | — | 9% | 6% |
| Other | 14.5% | 7% | 3% |
| Unknown | 20% | 27% | 28% |

## Pathogens Responsible for Nosocomial Bacteremia in the ICU

Bloodstream infections caused by gram-positive microorganisms are increasing in number.[1-3] Gram-positive microorganisms are now the major pathogens in cases of monomicrobial bacteremia (? 50%). Gram-negative microorganisms are identified in 30-40% of episodes. Fungemia represents less than 10% of the cases of nosocomial bacteremia in the ICU. Polymicrobial episodes are relatively common (10-20%). (*See Table 3.*)

## Prognosis of Nosocomial Bacteremia in the ICU

Bloodstream infections in the ICU are associated with a crude mortality that ranges between 30-80%.[1-5] The values of mortality directly associated with the episodes are lower, but still high (19-23%).[3,4] In addition, in case-control studies, the mortality rate directly attributable to the bloodstream infection is approximately 30%.[1,5] This means that the underlying disease makes a significant contribution to the crude mortality from bloodstream infection. Crude mortality is also associated with the severity of the patient's condition at the time of bacteremia and the grade of systemic response.[3] However, other microbiological and therapeutic variables may influence the outcome of critically ill patients with nosocomial bacteremia (related mortality): the source of the bacteremia, the type of microorganism involved, and the appropriateness of antibiotic treatment.

## The Source of Nosocomial Bacteremia as a Prognostic Factor

Studies analyzing the outcome of nosocomial bacteremia consistently show that episodes complicating lower respiratory tract or intra-abdominal infections are more frequently associated with a fatal outcome than episodes of bacteremia secondary to other sites.[2,4,6,7] Moreover, the influence on prognosis of the source of bacteremia remains when corrected by the severity of illness (as assessed by the APACHE II score).[3,8]

It is also well known that the grade of systemic response to the infection is an important prognostic factor of nosocomial bacteremia. The presence of septic shock is associated with higher crude and directly associated mortality. Since catheter-related bacteremia is associated with a significantly lower incidence of septic shock than bloodstream infections of an abdominal source, this may explain the difference in prognosis according to the source of the bacteremia. However, when the episodes of bacteremia with the same grade of systemic response to the infection are studied, related mortality again varies according to the source of the infection.[3,8]

**Table 3**

**Pathogens Responsible for Nosocomial Bacteremia in ICU**

| Author (Ref. #) | Gram-positive organisms | | Gram-negative organisms | | Fungi | |
|---|---|---|---|---|---|---|
| **Pittet (1)** | 51% | Coagulase-negative staphylococci<br>*Staphylococcus aureus*<br>Enterococci | 39% | *Enterobacter* spp.<br>*Klebsiella pneumoniae*<br>*Serratia marcescens* | 9% | *Candida* spp. |
| **Rello (4)** | 44% | Coagulase-negative staphylococci<br>*Staphylococcus aureus*<br>Enterococci | 40% | *Pseudomonas aeruginosa*<br>*Escherichia coli*<br>*Serratia marcescens* | 5% | *Candida* spp. |
| **Vallés (3)** | 50% | Coagulase-negative staphylococci<br>*Staphylococcus aureus*<br>Enterococci | 33% | *Pseudomonas aeruginosa*<br>*Acinetobacter baumannii*<br>*Klebsiella pneumoniae* | 4% | *Candida* spp. |

In fact, the source of the infection is an important prognostic factor even in the absence of bacteremia.[9,10] Gross and colleagues[9] studied a group of patients who died as a consequence of nosocomial infection, finding that lower respiratory tract infection was involved in 60% of those cases but urinary infection was present in only 17%.

### The Type of Microorganism Involved as a Prognostic Factor

Gram-negative bacteremias are associated with higher related mortality.[3] This is to be expected, in view of the higher virulence of these microorganisms, which present a higher incidence of severe sepsis and septic shock, and a higher incidence of bacteremias originating from sources other than a catheter.

In addition, the differences in the microorganisms involved according to the source of the bacteremia may explain the prognostic influence of the source of the bacteremia. However, when separated according to type of microorganism isolated, bacteremias secondary to lower respiratory tract infections present the highest mortality, and bacteremias originating from a catheter present lower mortality.[3,11]

### Appropriate Antibiotic Treatment as a Prognostic Factor

Empirical antibiotic treatment has been considered as one of the main factors influencing prognosis of episodes of bacteremia.[3,12] In a multicenter study with 590 consecutive episodes of nosocomial bacteremia in ICUs,[3] related mortality among patients who received inappropriate empirical antibiotic treatment was twice that in the group who received appropriate empirical treatment. (Empirical therapy for bacteremia was considered inappropriate when the microorganisms isolated in the bloodstream were not susceptible to the antimicrobial agents administered, or if the patient was not receiving empirical antimicrobial agents before the blood culture result was known.)

Also, in this case, even in the group of patients who receive appropriate empirical antibiotic therapy, related mortality differs according to the source of the infection. Bacteremias secondary to lower respiratory tract infections consistently have the highest mortality, and bacteremias originating from a catheter present low mortality.

### Practical Remarks

Underlying diseases and the severity of the patient's condition markedly influence crude mortality among ICU patients with nosocomial bacteremia. Furthermore, immediate prognosis after an episode of nosocomial bacteremia correlated with the grade of systemic response, the type of microorganism involved, and the different sources of bacteremia.

Intravascular catheters and lower respiratory tract infection are the main sources of bacteremia in these patients. Improving the prevention of catheter infection and nosocomial pneumonia is therefore a primary objective in attempts to reduce the incidence of bacteremia in the ICU.

Finally, the management of the systemic response to the infection and the appropriateness of antibiotic treatment are the most important modifiable variables affecting the outcome for patients with nosocomial bacteremia in ICU.

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*mial bacteremia in critically ill patients.[3])* ❖

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**Bloodstream infections in ICU patients are:**

a. mainly caused by gram-negative organisms and are associated with a high mortality.
b. often caused by gram-negative organisms and the main source are urinary infections.
c. associated with a low mortality and the main sources are catheter-related and lower respiratory tract infections.
d. mainly secondary to catheter-related and lower respiratory tract infections and gram-positive organisms are now the leading pathogens.
e. mainly secondary to catheter-related and lower respiratory tract infections and most of the episodes are polymicrobial bacteremias.

## In Future Issues:

New Technique for Excluding Esophageal Intubation

Can Hyperoxia Overcome Hyperventilation-Induced Cerebral Ischemia?