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CRITICAL CARE ALERT™

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Which Amphotericin for Neutropenic Fever?

ABSTRACT & COMMENTARY

Fungal infections are increasing in incidence in neutropenic patients. There are several causes for this, not the least of which is the fact that patients are living longer due to better prophylaxis against bacterial and viral infection. As a result, intensivists are more often faced with patients with neutropenic fever. High proportions of patients with persistent fever while neutropenic have occult fungal infection. The majority of these patients who develop pulmonary infiltrates require antifungal agents to resolve the pneumonia. The conventional treatment for persistent neutropenic fever is amphotericin B. Toxicity, especially nephrotoxicity, limits the dose of drug that can be given. Daily dosing usually is limited to 1.0 to 1.5 mg/kg. Several available lipid-based amphotericin B preparations are associated with fewer side effects and therefore can be dosed at higher daily levels. The National Institutes of Allergy and Infectious Diseases Mycoses Study Group conducted a randomized, double-blinded, multicenter trial to compare the efficacy and toxicities of liposomal amphotericin B (AmBisome*) with conventional amphotericin B in the empirical treatment of fever in persistently neutropenic patients. The study used well-recognized parameters for defining persistent neutropenic fever. Walsh and colleagues randomized a total of 687 patients in this study. The mean daily dose of each agent was amphotericin B, 0.6 mg/kg, and liposomal drug, 3.0 mg/kg. Durations of treatment were not significantly different in the two patient groups.

There were no significant differences in successful treatments between the groups (50% for liposomal amphotericin B, 49% for conventional amphotericin B). Neither antifungal prophylaxis nor growth factor use influenced success. In addition, there were no significant differences in survival (93% and 90%), resolution of fever (58% for each), or discontinuation of the drugs due to toxicity or lack of efficacy (14% and 19%). Toxicity was less common with the liposomal preparation compared to conventional amphotericin B. There was less frequent nephrotoxicity (creatinine more than twice the upper limits of normal; 19% and 34%), infusion-related fever (17% and 44%), chills or rigors (18% and 54%), and breakthrough fungal infection (3% and 8%) with the liposomal preparation. (Walsh TJ, et al. *N Engl J Med* 1999;340:764-771.)

INSIDE

COMMENT BY STEPHEN W. CRAWFORD, MD

Currently, there is only one published study that reports a superior outcome of a lipid-based amphotericin B compared to conventional amphotericin B in treatment of fungal infection in neutropenia (Leenders AC, et al. *Br J Haematol* 1998;103:205-212). However, all studies uniformly conclude that any of the three available lipid preparations cause fewer side effects, especially renal impairment. This NIAID study is important because of its size. However, it does not give us the definitive answer about whether to use conventional amphotericin B or a lipid-based version. Toxicity is less: not absent, but less. This alone does not warrant the significant additional cost of the liposomal amphotericin B. Outcome is not different in empirical treatment in neutropenic fever. In most cases, I believe we should use conventional amphotericin B for empirical treatment and consider alternative agents in the case of severe toxicity.

Should we use lipid-based amphotericin B in the case of proven (or highly suspected) invasive fungal infection? The answer is not yet in. It is clear from numerous studies that the critical determinant of successful outcome of invasive fungal infection in the neutropenic patient is the recovery of granulocyte numbers and function; the choice of antifungal agent may be of secondary importance. In addition, the mortality rate for neutropenic patients with proven or suspected invasive pulmonary aspergillosis is high and there are many competing causes of death in these patients. Demonstrating a benefit from any change in therapy will be difficult.

In general, I still advocate initiating treatment with conventional amphotericin B for most immunosuppressed patients with persistent neutropenic fever or suspected fungal infection. However, the immunosuppressed patient in the intensive care unit may present a specific case for starting with a lipid-based amphotericin B. The presence of other critical illness (particularly renal insufficiency) in such a patient may warrant assuming the additional cost of these drugs in an effort to limit as much as possible additional toxicity. This NIAID-sponsored study suggests that when we do not know the best way to cure, we should choose the way least likely to harm the patient. ❖

Compared to conventional amphotericin B, liposomal amphotericin B in patients with persistent neutropenic fever:

a. causes less nephrotoxity.
b. causes less infusion-related fever.
c. causes less chills and rigors.
d. does not improve survival.
e. All of the above

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Minocycline-Rifampin Impregnated IV Catheters Superior

ABSTRACT & COMMENTARY

Synopsis: *Central venous catheters impregnated with minocycline and rifampin (MR) were compared to catheters impregnated with chlorhexidine and silver sulfadiazine (SS) and found to be superior with respect to the rates of catheter colonization and bloodstream infection (BSI). Colonization rates were 7.9% for the MR and 22.8% for the SS groups. Only one BSI occurred with the 356 MR catheters (0.3%), as compared to 13 BSIs with the 382 SS catheters (3.4%) (P < 0.002).*

Source: Darouiche RO, et al. *N Engl J Med* 1999; 340:1-8.

Patients at 12 university teaching hospitals who needed central venous catheters inserted as part of their management and were predicted to need the venous access for more than three days were randomized to receive a 20-cm-long, triple-lumen, polyurethane catheter impregnated with either minocycline-rifampin (MR) or chlorhexidine-silver sulfadiazine (SS). Only catheters placed with a new percutaneous stick were entered into the

study, not those changed over a wire. At the time of catheter removal, the tip and subcutaneous segments were cultured. If a bloodstream infection (BSI) was suspected, blood was cultured and the catheter removed. Organisms obtained from more than one site were DNA typed for identification. Clinical indications directed catheter removal.

A total of 865 study catheters were placed in 817 patients; complete data were collected for 738 catheters (85%) in 689 patients. The two groups were similar in important characteristics: the catheters were in place an average of 8.2 (SS) and 8.4 (MR) days; 67% of patients were in an ICU; 16% were receiving hyperalimentation; and the patients were an average of 56 years old in both groups. Catheter colonization and BSI rates were significantly lower in the MR group (7.9% and 0.3%) than in the SS group (22.8% and 1.3%). In 71% of patients with a BSI, the same organism was found on the skin, on the catheter, and in the blood. Two patients died as a result of a BSI, both of them in the SS group. No local or systemic hypersensitivity reactions were noted with any catheter.

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

This is an impressive and important study—the first head-to-head comparison of these expensive but effective special catheters. The variety of institutions that participated and the large number of catheters studied supports Darouiche and colleagues' contention of the superiority of the MR over the SS-impregnated catheter. Both types of impregnated catheters have been shown to reduce nosocomial infection and colonization rates when compared to unimpregnated controls. The large difference between them in this study is surprising.

The colonization rate for SS catheters found in this study is high—so high, in fact, that one might wonder if the SS catheters were defective. This rate is the same as those reported for controls in many previous studies of SS catheters. The highest colonization rate for SS catheters was reported by one of the authors of this study—40% with 52% of control catheters becoming colonized (Heard SO, et al. *Arch Intern Med* 1998;158:81-87). Heard reported little difference in BSI, 3.3% as compared with 3.8% in that study. Most other studies of the SS catheter against controls show advantages, and a well-designed meta-analysis of 12 reported studies including more than 2000 catheters demonstrated more than 50% reduction in colonization and BSI rates with SS catheters (Veenstra DL, et al. *JAMA* 1999;281[3]:261-267).

A problem with this study is the MR catheter used. As compared to previous studies, this "new" catheter was impregnated on the internal as well as external surface with the antibiotics. Approximately three to five times the amount of antibiotic was found on these catheters as on catheters used in previous studies. Although no complications related to antibiotic resistance were found in any of the catheter-related nosocomial infections, antibiograms of the patients' other organisms were not carried out in this study. Whether this higher dose of antibiotic will create a resistance problem is not yet known.

The technique used to identify colonization used in this study was not standard. Darouiche et al sonicated the catheter tips in broth after rolling them on plates. This was thought to release trapped organisms from the inside of the catheter, identifying hidden colonization. The validity and reliability of this technique has not been widely tested. Darouiche et al state that using conventional definitions of colonization (more than 15 colony-forming units from the rolled tip) did not change their results, although they did not report this information for independent confirmation. The sonication culture technique probably overestimates the actual colonization rate. Despite this criticism, the BSI rate is impressively reduced with these MR catheters.

Finally, cost information was only indirectly mentioned. The MR catheters cost approximately $9.00 more per unit, and about $60.00 more than conventional central venous catheters. To make cost-effectiveness decisions it is necessary to know the exact cost of the devices to an individual institution. Limiting the use of these effective but expensive catheters to those patients at high risk is the appropriate initial strategy. The catheters must be left in place through a fever and only suspected as the source when all other causes of infection are ruled out. If local practice is to change the catheter at the first temperature rise, then no benefit will be realized. The mechanical risks of changing catheters (which includes death) outweigh the benefits of preventing a small number of BSIs resulting from leaving the antibiotic catheter in place a few days longer. Patients developing fevers should have an evaluation for the presence of an infection. Infrequently, after a workup, the central venous line will be found to be the source. Only if positive blood cultures are found should the catheter be thought to be the primary source. ❖

Minocycline-rifampin-impregnated CV catheters:

a. are less expensive than chlorhexidine-silver sulfadiazine (SS) impregnated catheters.
b. are more likely to cause allergic reactions than SS catheters.
c. are less likely to cause bloodstream infections than SS catheters.
d. increase the resistance of organisms recovered from patients.
e. should replace all conventional CV catheters.

Doctor, Wash Your Hands!

ABSTRACT & COMMENTARY

Synopsis: *In 2834 observed patient care situations in which handwashing was indicated, the latter took place in only 48%. Noncompliance with handwashing was more frequent in intensive care units and among physicians as compared to other healthcare workers.*

Source: Pittet D, et al. *Ann Intern Med* 1999;130: 126-130.

In this observational study in a large teaching hospital, trained infection-control nurses recorded potential opportunities for and actual performance of handwashing during 20-minute observation periods spaced randomly during all shifts over a period of 14 days. Observations were made in a sample of 48 wards, including intensive care units, that comprised 70% of the hospital's 1382 beds. Opportunities for handwashing were defined as all situations in which it was indicated according to published guidelines. Personnel were not aware of which aspects of handwashing were being studied, and no feedback was given during the data collection.

In 2834 opportunities for handwashing, average compliance among all healthcare workers was 48%. Compliance with handwashing in the 450 opportunities in intensive care units was 36% (odds ratio for noncompliance compared to internal medicine units, 2.0, with 95% CI 1.3-3.1). As a group, physicians washed their hands least often of the types of healthcare workers studied: with the odds ratio for noncompliance among nurses taken as 1.0, that for physicians was 2.8 (95% CI, 1.9-4.1) by multivariate analysis, while that for nursing assistants was 1.3 (95% CI, 1.0-1.6). The odds ratio for noncompliance among other healthcare workers was intermediate between those of physicians and nurses.

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

In this study from Geneva, Switzerland, handwashing was considered to be indicated before and after patient contact; whenever there had been contact with body fluids, broken skin, or other potential sources of microorganisms; and after removing gloves. These criteria are consistent with those in most American hospitals, and the fact that handwashing occurred on average less than half the time when it was indicated is discouraging. Other studies have documented the low overall rate of handwashing in hospitals, particularly in intensive care units. In addition, this is not the first study to show that physicians perform less well in this respect than do nurses and other healthcare workers. In this time of increasing emergence of bacterial pathogens resistant to multiple antimicrobials, we need to emphasize the importance of handwashing, probably the most important single factor in the nosocomial transmission of such organisms. Doctor (and nurse, respiratory therapist, anyone involved in patient care)—wash your hands! ❖

In the study of Pittet et al, how often did handwashing occur overall, when it was indicated in patient care situations?

a. 88% of the time
b. 70% of the time
c. 57% of the time
d. 48% of the time
e. 31% of the time

Special Feature

Differential Lung Ventilation

By Charles G. Durbin, Jr., MD, FCCM

Advances in respiratory therapy and mechanical ventilation have led to improved outcome from a variety of lung diseases. The mortality and morbidity associated with the acute respiratory distress syndrome (ARDS) continue to challenge clinicians and have led to the application of a "lung protective strategy" for mechanical ventilation in these patients. This approach derives from the concept that ARDS consists of inhomogeneous distribution of pathology (i.e., there are normal alveoli distributed throughout the lung, with the majority of alveoli unavailable for any gas exchange). Large tidal volumes will be distributed only to the normal alveoli, these alveoli will become overdistended and suffer barotrauma or, more properly, "volutrauma."

Likewise, positive end expiratory pressure (PEEP) will only be distributed to open or normal alveoli, increasing overdistension, causing barotrauma, and redistributing blood flow to collapsed areas of lung, thus, worsening gas exchange. By using small tidal volumes and limiting plateau pressures during mechanical ventilation, it is believed that iatrogenic lung damage may be minimized and an improved patient outcome will result.

Although this approach has not been unequivocally proven to be of benefit, the concept of inhomogeneity is supported by anatomic and pathologic evidence, and centers that embrace a lung protective strategy report improved survival from ARDS. What is apparent is that ARDS is not a homogeneous disease, and that some areas are more damaged than others. Application of a therapy to the entire lung will result in a balance between desired effects in the diseased areas and undesired effects in normal areas.

In addition to ARDS, most other pulmonary disorders

are not uniformly distributed. Sometimes the inhomogeneity is so great that each lung may have grossly different compliance and gas exchange properties. In cases of lobar pneumonia this is readily apparent. Following single-lung transplantation, differences in compliance and function are expected and persist indefinitely. The population of patients with unilateral lung disorders is becoming larger. When patients with different lung compliances require mechanical ventilation and PEEP, pressure and volume therapy may be inappropriately distributed (i.e., the most compliant [most normal] lung will receive most of the pressure and volume, possibly sustaining volutrauma and redistributing blood flow to the "bad" lung).

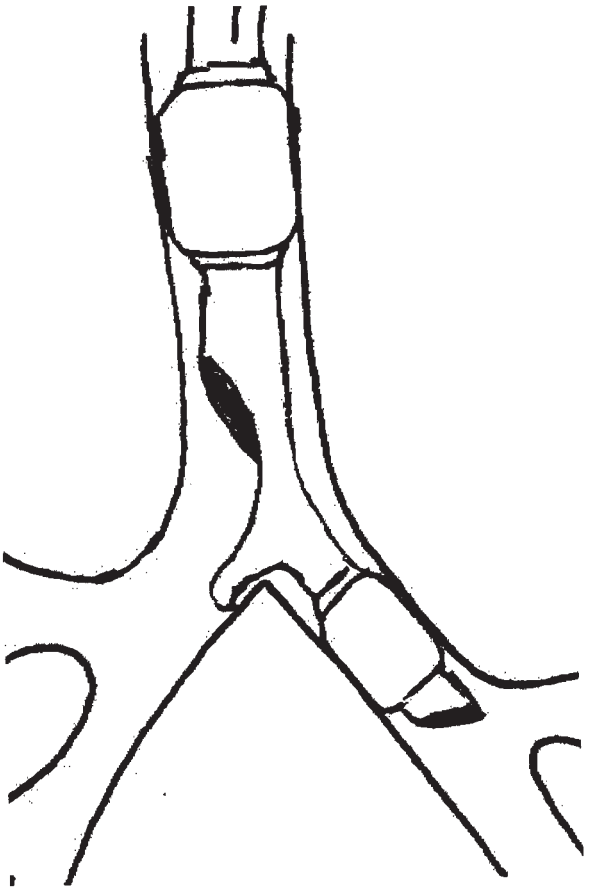
Differential lung ventilation may help prevent this maldistribution of support and treatment. While initially an attractive concept, the risks and difficulties of differential lung ventilation are significant. In this review, the indications, available options, risks, and alternatives to lung isolation and differential ventilation will be discussed.

The experience in differential lung ventilation has been driven by advances in lung and aortic surgery. More than 50 years ago, differential lung spirometry was performed using double-lumen endobronchial tubes (DLET) made of stiff rubber with two latex cuffs (the Carlin's tube with a left bronchial lumen and the White tube with a right bronchial lumen). Oxygen consumption by each lung was measured in awake subjects to determine if the patient could survive pneumonectomy. These original tubes, still available, have carinal hooks to facilitate correct placement, are difficult to insert through the larynx, and have high-pressure cuffs that would cause severe bronchial injury if left in place for an extended period. (*See Figure 1*.) Modern plastics and fiberoptic bronchoscopy have improved the success of placement and reduced complications of these original DLETs.

Single-Lung Anesthesia

Complicated open surgery of structures within the thorax (e.g., lungs and their associated large airways, esophagus, the chain of sympathetic nervous system ganglia, thoracic vertebrae, thoracic lymphatic system, and the thoracic portions of the great blood vessels) is facilitated by the technique of one-lung anesthesia. (See Table 1.) Thoracoscopic, video-directed procedures are becoming more common. Single-lung anesthesia is essential for success of these "minimally invasive" procedures. One lung is selected for isolation and collapse, while the other lung is ventilated, providing gas exchange for the patient. This approach produces excellent visualization of the thoracic structures and markedly reduces movement within the operated hemithorax. During partial or total pneumonectomy deflation of the resected lung allows careful, deliberate dissection and control of vessels and bronchi prior to clamping the specimen. During vascular procedures such as aortic aneurysmectomy, deflation of the lung protects it from severe bleeding and contusion, which may occur due to systemic anticoagulation.

Anesthetic concerns during one-lung ventilation are many. Besides the mechanical problems of lung separation, providing adequate oxygenation and CO_2 excretion as well as maintaining appropriate anesthetic depth can be a challenge. Usually CO_2 excretion can be maintained with one lung simply by maintaining a relatively normal minute ventilation of the single lung. This is probably best done by increasing respiratory rate and decreasing tidal volume, thus avoiding excessively high airway pressures.



If the patient has severe chronic obstructive pulmonary disease (COPD) or active bronchoconstriction, intrinsic PEEP may develop in the ventilated lung, and a slower respiratory rate with better exhalation may be preferable, accepting a rise in $PaCO_2$. Intrinsic or added PEEP may significantly worsen oxygenation by directing blood from the ventilated lung to the totally col-

lapsed lung, acting like a right to left shunt.

Figure

The Carlin's Tube with a Carinal Hook

If oxygenation is a problem during single-lung ventilation on 100% O_2, PEEP applied to the ventilated lung may improve gas exchange if more collapsed alveoli are recruited than blood redirected to the collapsed lung. This balance must be empirically evaluated. Since most patients requiring thoracic procedures do not have normal cardiopulmonary function, they often do not tolerate single-lung ventilation for the extended periods necessary for completion of the surgical procedure. PEEP or CPAP on the collapsed lung may redirect blood to the ventilated lung; however, this will inflate the operated lung and make surgery difficult. Use of 100% oxygen in the lung for several minutes prior to collapse will prevent oxygen desaturation for a while during lung collapse. Periodic reinflation may be necessary to prevent severe desaturations during the procedure.

A final solution to hypoxemia during single-lung ventilation is to have the surgeon occlude the pulmonary artery of the collapsed lung. This will direct all the pulmonary blood to the ventilated lung and allow optimal oxygen exchange. A pulmonary artery balloon-tipped catheter in the collapsed lung can achieve a similar effect on balloon inflation. However, this must be placed with the lung inflated and will only restrict some of the blood flow. At the conclusion of surgery the collapsed lung is re-expanded and two-lung ventilation is re-established.

Table 1

Procedures Facilitated by Single-Lung Anesthesia

Open thorax lung surgery
Pneumonectomy
Lobectomy
Bullectomy
Lung reduction surgery
Repair of bronchial tear/rupture
Pleural tumor resection
Closed thorax lung surgery
Pleurodesis
Lung tumor biopsy
Diagnostic thoracostomy
Mediastinal node biopsy
Aortic arch surgery
Aortic aneurysmectomy
Repair of traumatic aortic rupture
Thoracic sympathectomy
Repair of thoracic duct
Anterior fusion of thoracic spine
Cardiac surgery
Repair of PDA
Mitral valve replacement
Tricuspid valve replacement
Esophageal surgery
Repair of esophageal rupture
Resection of diverticulum
Repair of tracheo-esophageal fistula

Use of Double-Lumen Endotracheal Tubes

There are several versions of the DLET on the market. The most popular has no carinal hook and is constructed of the same nonreactive materials as regular endotracheal tubes (ET). This tube without a carinal hook is termed the Robertshaw design and is produced in a right- or left-sided model. DLETs are available in a variety of sizes, 28 French (Fr), 35 Fr, 37 Fr, 39 Fr, and 41 Fr. These tubes are about 42 cm long and are produced by several different manufacturers.

The choice of size is dependent on the patient's anatomy and is crucial since a DLET too large will not fit into the mainstem bronchus and is difficult to pass through the glottis. A DLET too small requires an inordinate amount of cuff air to obtain a seal resulting in high pressures applied to the bronchial mucosa. Also, the smaller the DLET, the higher the resistance to airflow. For example, the airflow resistance of the endobronchial side of a 39 Fr DLET is about equivalent to a 7.0 mm internal diameter (ID) single-lumen ET, while a 35 Fr DLET is about equivalent to a 6.0 ID ET. The lumens of a DLET are not perfectly round, as they are in a single-lumen ET. The tracheal lumen is D-shaped, with the flat portion of the lumen abutting the shared wall with the endobronchial lumen. This imposes significant limitations for the passage of suction catheters and fiberoptic bronchoscopes.

All disposable and reusable DLETs have their length marked in centimeters to aid in correct placement. As a first approximation, the average depth of insertion for both males and females 170 cm tall is 29 cm at the teeth. For each 10-cm increase or decrease in height, the placement depth will be increased or decreased approximately 1 cm. Besides the distance markings and tube size, each DLET has a radiopaque ring marker around the endobronchial lumen lip and one proximal to the

bronchial cuff as well as a line running its length to aid visualization on chest roentgenograms.

Correct placement of the bronchial lumen is essential for success of the lung separation and to minimize complications. Single-use DLETs come disassembled in sterile packages and must be assembled and tested prior to use. The components are removed from their packages and placed on a clean surface. The Cobb adapter is an adapter that permits both lumens to attach to a single ventilation source, whether ventilator or manual device. The endobronchial and tracheal cuffs are tested for leaks and symmetry after inflation. The DLET is inserted with the cuffs deflated. A soft metal bronchial lumen stylette is packaged with the DLET and should be lubricated lightly with a non-petroleum-based lubricant to allow easy removal after the tube is placed. The tip of the DLET can be shaped to facilitate seating of the tube with this stylette.

All DLETs are bulky and stiff compared to their single-lumen counterparts. Their introduction through the glottis is considerably more difficult and great care must be taken to avoid damage to the DLET or the patient during intubation. Intubation of the trachea with a DLET is usually performed only in anesthetized patients with the aid of a neuromuscular blocking agent. With the patient's head and neck in the ideal or "sniffing" position, the patient breathes 100% oxygen for several minutes to remove nitrogen from the lungs. This period of preoxygenation (more correctly called "denitrogenation") provides a margin of safety as insertion of the DLET may take several minutes.

The natural curvature of the endobronchial tip facilitates placement in the right or left mainstem bronchus as the DLET is advanced. The curve interferes with passage through the glottis. With the glottic opening in view, the tip of the endobronchial tube is inserted between the open vocal cords with the preformed curvature directed anteriorly. As the endobronchial cuff passes through the vocal cords, the DLET is rotated approximately 90-100° to align the curved tip with the orientation of the mainstem bronchus to be intubated. At this point, some clinicians halt and remove the stylette to allow the tip more flexibility and to possibly cause less damage rubbing the tracheal wall.

Contrary to this common misconception, tracheal damage is not caused by leaving the stylette in until the DLET is in its final position in the bronchus. When further advancement of the DLET is met with resistance, it is seated in the bronchus. The tracheal cuff is inflated to form a seal and the Cobb adapter with the two ET fittings is inserted into the proximal lumens. As the lungs are inflated, the chest is assessed visually, by auscultation, and by measurement of exhaled carbon.

The final step is the fine adjustment of the DLET to enable isolation of the lungs without unintentional obstruction of the airways. The endobronchial cuff is inflated and the chest is carefully auscultated bilaterally while the tracheal and endobronchial lumens are sequentially occluded with a clamp. When the DLET is correctly placed, obvious separation of breath sounds will be readily identifiable with clamping and unclamping of each lumen. Unfortunately, even when strict criteria are applied, between 38% and 83% of DLETs placed by auscultatory means alone are malpositioned when examined using a fiberoptic bronchoscope. Final assessment of correct DLET placement by fiberoptic bronchoscopy is mandatory.

Because movement of the DLET is possible whenever movement of the patient occurs, bronchoscopy should be repeated after any patient position change. Correct DLET placement is confirmed when the blue bronchial cuff is seen protruding slightly at the carina. A pediatric fiberoptic bronchoscope is passed through the tracheal lumen, confirming bronchial cannulation. Airway secretions are difficult to remove with these small diameter scopes. If a right-sided tube is selected, the orifice of the right upper lobe can be visualized through the Murphy eye of the bronchial lumen. Due to patient variations, it may not be possible to obtain unobstructed ventilation of the right upper lobe with right-sided tubes. For this reason, a left-sided tube should always be used if possible.

Tubes often move up or down the trachea when the patient's position or head is moved, even when the tube is firmly anchored in the mouth. Frequent re-evaluation and repeated bronchoscopy are necessary to maintain lung separation.

Lung separation may be achieved in two other ways: bronchial blockers and bronchial intubation with a single-lumen ET. Neither of these is ideal as access to and manipulation of the unitubated lung is minimal. However, in emergencies, such as massive hemoptysis, advancement of the single-lumen ET into the uninvolved lung may be life saving by preventing contamination of the "good" lung while definitive treatment is initiated.

Independent Lung Ventilation (ILV) in the ICU

DLETs may be used to allow independent lung ventilation in ICU patients with unilateral lung disease. A list of conditions treated this way is presented in Table 2. Uncontrolled bronchopleural cutaneous fistulas (BPCF),

unilateral ARDS, unilateral pneumonia, unilateral air trapping, and ARDS following single-lung transplant have been successfully treated with ILV. Almost all patients will require controlled mechanical ventilation, as initiating a breath through the DLET requires significant patient work. Neuromuscular blocking agents are almost always used to facilitate CMV and prevent patient movement that may cause tube displacement.

Table 2

Conditions Amenable to Independent Lung Ventilation

Unilateral pneumonia
Pulmonary hemorrhage
Pulmonary artery rupture from PA catheter balloon
ARDS following lung transplant
Unilateral ARDS
Massive air leak from broncho-pleural-cutaneous fistula
Unilateral air trapping from asthma or COPD

When ILV is used, two ventilators are usually needed—one for each lung. Synchronizing the ventilators can be done by connecting them with a special cable and using one ventilator as a controller of the other. Most modern ventilators permit this technique, but how it is accomplished varies by manufacturer. Since ILV is infrequently performed in most institutions, the mechanical details of ventilator preparation should be written down and practiced in advance.

It may not be necessary to synchronize the ventilators. In hemodynamically stable patients, the mediastinal shifts that may occur with unsynchronized ILV may be well tolerated, making management more simple. This is particularly true when only CPAP is needed on one lung. Most patients will need conversion to single-lumen ET prior to weaning from mechanical ventilation.

Because of the risk of bronchial mucosal damage and bronchial stenosis, ILV should be performed for as short a period as possible, usually two to three days at most; however, longer use (30 days) without tracheal complications has been reported. The difficulty in secretion removal, inability to allow spontaneous ventilation, and need for sedation and paralysis makes ILV a short-term, life-saving modality rather than a reasonable elective choice for support. However, with this modality, in some patients with rapidly reversible unilateral lung disease who cannot be adequately managed with conventional MV, improved gas exchange and improved survival can be achieved. ❖

Double-lumen endotracheal tubes are not indicated for treatment of which of the following?

a. Massive hemoptysis
b. Unilateral ARDS
c. Lung resection for tumor
d. *Pneumocystis carinii* pneumonia
e. Traumatic thoracic aortic rupture

Correction

An error appeared in the April 1999 issue of *Critical Care Alert*. The reference to the first abstract and commentary on page 1 was inadvertently omitted from the end of the first paragraph. The reference to the article summarized in "Variability of arterial PO_2 in critically ill patients," is Tsai Y-H, et al. *Intensive Care Med* 1999;25:37-43. We regret any confusion this may have caused. ❖

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