

## TOTAL PARENTERAL NUTRITION AND INFECTIONS ASSOCIATED WITH USE OF CENTRAL VENOUS CATHETERS

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The article in this issue by Dimick et al<sup>1</sup> about total parenteral nutrition (TPN) and infections associated with use of central venous catheters addresses a major concern in critical care medicine. In day-to-day practice, certain intervention-related complications are inevitable. As our understanding in general improves, we find many other factors that contribute to complications. Dimick et al indicate that with proper care, infection related to central venous catheters used for TPN is avoidable.

As critical care medicine continues to advance, outcomes improve and interventions previously considered high risk become safer. Two vital components of critical care are the use of central venous catheters and TPN. The most severely ill patients often require both for survival and recovery. In the intensive care unit, gastrointestinal dysfunction associated with multiorgan failure and shock or with abdominal surgery is not uncommon. Nutrition cannot be compromised.<sup>2</sup> However, when TPN is suggested for a patient, the risk of infectious complications, especially infection related to use of central venous catheters, is often thought greater than potential benefits.

Why is this risk so often weighed with greater importance than are other clinical factors? Does this concern have merit, or is it simply an overreaction? Catheter-related infection is potentially devastating. Such infections greatly increase morbidity, mortality,<sup>3,4</sup> and length of stay.<sup>5</sup> Pittet and Wenzel<sup>4</sup> reported an odds ratio for death of 20.45 (95% CI, 18.9-22.1) for patients with catheter-related infection. Thus, the concern is understandable because of the potential consequences.

A decade ago, Kudsk et al<sup>6</sup> compared the prevalence of septic complications in a group of severely ill trauma patients who received either TPN or enteral

feeding. The group given TPN had significantly higher prevalences of pneumonia (31% vs 11.8%;  $P < .02$ ), intra-abdominal abscess (13.3% vs 1.9%;  $P < .04$ ) and catheter sepsis (13.3% vs 1.9%;  $P < .04$ ). Other investigators<sup>7</sup> reported similar data. The large difference in rates between patients given TPN and those given enteral feedings makes it difficult to argue a lack of association between TPN and infectious complications.

The question yet to be answered about TPN is, despite the inherent infectious risks, can infectious complications be avoided? Dimick et al<sup>1</sup> have begun to answer this question. Now that a decade has passed, the research of Dimick et al and that of other investigators has improved safety for interventions commonly used in critically ill patients.

The earlier studies on TPN were performed without glucose control. Recently, van den Berghe et al<sup>8</sup> reported that tight glucose control decreased mortality significantly (8.0% with conventional treatment vs 4.6% with tight glucose control,  $P < .04$ ). Were the increases in infectious complications in the earlier reports a direct result of poorly controlled hyperglycemia? If euglycemia had been achieved, would the differences in infectious rates found by Kudsk et al<sup>6</sup> and Moore et al<sup>7</sup> have been smaller or nonexistent?

Of all the potentially devastating infectious complications, catheter-related infection remains the major concern associated with use of TPN. Because of the wide use of central catheters and the potential for devastating outcomes, the concerns are not surprising. However, because early provision of nutritional support improves outcomes in critically ill patients,<sup>1</sup> avoiding or delaying administration of TPN solutions is potentially harmful. Having guidelines to use TPN and yet avoid catheter-related infection may markedly improve outcome. The findings of Dimick et al<sup>1</sup> have begun to dispel myths about catheter-related infection associated with use of TPN and give clinicians proper directions on how to use TPN safely.

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The data reported by Dimick et al are insightful. The findings indicate that with proper care, TPN does not necessarily result in catheter-related infection. Proper insertion and care of catheters are essential to avoid infection. Eggimann et al<sup>9</sup> found a dramatic reduction in overall bloodstream infections (from 22.9 to 6.2 episodes per 1000 catheter-days; relative risk, 0.27; 95% CI, 0.13-0.56) when a uniform protocol stressing sterile insertion and proper care of catheters was instituted. The data reported by Dimick et al<sup>1</sup> were gathered in the setting of excellent catheter care. The intense dressing care reflects the high level of training of personnel at their institution. The personnel dedicated to catheter care significantly contributed to the decrease in catheter-related infection. Although Dimick et al do not explicitly describe the experience of the nutrition team, given the framework of how the data were gathered, I assume that the members of the team were experienced and/or well supervised.

The percentage of catheter-related infections is lower for single-lumen catheters than for multilumen catheters. Farkas et al<sup>10</sup> reported a large difference: 11.5% for single-lumen versus 16.2% for multilumen. Although the reason for the decreased risk of infection associated with use of single-lumen catheters remains unproved, it most likely is less manipulation. Multilumen catheters are used to administer multiple medications in multiple intervals; these catheters are manipulated far more than single-lumen catheters are. The chance of a break in the sterile barrier and resultant infection is higher for the multilumen devices.

Another risk factor for catheter-related infection reported by Dimick et al<sup>1</sup> is pulmonary artery catheters. Again, increased manipulation (obtaining pulmonary occlusion pressures and injecting fluid for thermodilution measurements of cardiac output) contributes to increased prevalence of infection. My colleagues and I recently reported similar data<sup>11</sup>; we found that colonization rates were higher for pulmonary artery catheters (5.26%) than for central venous catheters (2.89%). Surprisingly, however, the infection rate was actually lower for pulmonary artery catheters (1.05%) than for central venous catheters (2.29%). In our study, senior-level physicians used strict sterile technique to insert the catheters, and a group of nurses dedicated to the intensive care unit subsequently provided excellent catheter care. In addition, unnecessary catheter manipulation was limited; routine measurements of cardiac output and pulmonary artery occlusion pressures were not made. Only senior-level physicians were allowed to manipulate pulmonary artery catheters for measurements of pulmonary artery occlusion pressure and cardiac output. We pos-

tulate that although minimizing these otherwise routine interventions could not completely eliminate the higher inherent risk of colonization, it did lower the prevalence of catheter-related infection.

Increased risk of infection with pulmonary artery and multilumen catheters will not surprise most clinicians; however, increased risk of infection with catheters in the internal jugular vein may come as a surprise to some. As a common practice, catheters are placed in the internal jugular vein to avoid infection. Several articles<sup>12-14</sup> indicate that the risk of contamination of these catheters is high. This finding is not surprising to most experienced intensive care unit nurses. In our study, our experienced nurses reported that dressing care was more difficult in patients with internal jugular catheters because of constant neck movements. Dressing care was less of a problem for catheters at the other sites. Good dressing care is essential to avoid catheter-related infection. Of all the commonly used central catheter sites, the risk of infection is lowest for the subclavian vein.<sup>14</sup> The reasons for the lower risk most likely are minimal movements and distance from saliva and sputum. Furthermore, tracheostomy collars and other hardware do not interfere with catheter care.

Catheters impregnated with antiseptics<sup>15</sup> and coated with antibiotics<sup>13</sup> are now available. Both types are associated with significant decreases in infectious complications. Conceivably, these catheters can be used in situations in which the risk of catheter-related infection is high, including use for TPN. Using these new catheters may contribute to decreases in infections associated with catheters used for TPN.

Although the study by Dimick et al<sup>1</sup> is a retrospective subanalysis of data gathered for another study, the results are clinically useful. They indicate that despite the inherent risk for infectious complications associated with use of catheters for TPN, proper care of the catheters effectively reduces infectious outcomes. Although the observation is insightful, the feasibility of having a single-lumen catheter in the subclavian vein dedicated solely to TPN is not practical. However, having 1 lumen of a multilumen catheter dedicated to administration of TPN solutions, with skilled personnel inserting and caring for the catheter, is practical.

Critical care medicine continues to advance. Our understanding of interventions such as use of central venous catheters and TPN continues to improve. Nutrition is a cornerstone for improved outcomes. Misunderstood risks should not delay or deter clinicians from using TPN. However, proper training of personnel is essential. If an institution continues to

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have a high prevalence of catheter-related infection associated with catheters used for TPN, training personnel to care for central venous catheters, as described by Dimick et al, is an effective method to reduce this devastating complication.

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