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Central venous catheter insertion in septic patients admitted from the emergency department: it's all in the timing

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Management of sepsis is time sensitive. The faster therapy is initiated, the higher the likelihood for a positive outcome. While the optimal treatment for severe sepsis and septic shock is multifactorial, a cornerstone of management includes placement of a central venous catheter (CVC) in order to administer vasoactive agents, and measure central venous pressure and central venous oxygenation when appropriate. In this issue of *Critical Care Medicine*, Theodoro et al (1) examine the utilization and timing of CVCs in patients admitted from the ED with a diagnosis of sepsis or respiratory arrest. A total of 25% of all ED admissions that underwent CVC placement at 310 hospitals in California between 2003 and 2006 were analyzed. Procedures were categorized based on when a CVC was inserted, with insertion on day 0 of hospitalization classified as emergent, insertion on days 1–2 classified as urgent, and insertion on day 3 or beyond classified as late.

The authors found a striking increase in emergent CVC insertion, with absolute numbers more than doubling from 2,957 to 6,290 over the four years of the study. Since a retrospective database analysis cannot explain changes in clinical practice, we are left to speculate as to why this remarkable increase occurred. An attractive explanation is that the increase in emergent CVC placement for sepsis reflects increasing provider knowledge of and acceptance of Early Goal Directed Therapy (EGDT) (2), a concept that was published shortly prior to the time period examined. As described by Rivers et al, EGDT leads to impressive improvements in the outcome of septic patients via protocolized management, including mandatory CVC placement. Broader acceptance of EGDT likely resulted from the first version of the Surviving Sepsis Campaign guidelines, (3). Recommendations from this landmark campaign to decrease mortality from sepsis were highly publicized and disseminated, leading to a plausible explanation of why CVC placement occurred earlier in a septic patient's hospitalization.

However, other alternatives must be considered as well. The consensus definition of sepsis was introduced only a decade before the data collected by Theodoro et al. (4), and, it is possible that providers were not fully aware of a syndrome which had only been recently formally defined. If more clinicians recognized patients as being septic, it stands to reason that more would be treated appropriately. Alternatively, increased CVC placement for sepsis might be secondary to an increased incidence of the disease. It has recently been reported

that the incidence of severe sepsis is increasing by 13% annually (5). If improvements in overall medical care result in an aging population that is more prone to develop sepsis, more patients may require treatment for the disease. It is also impossible to rule out that increased CVC “usage” was actually a result of changes in documentation rather than a real change in practice. New ICD-9 codes for sepsis, severe sepsis and septic shock were introduced around the time that the analysis by Theodoro et al. was performed (5). Increased coding of the disease would give the appearance of more patients receiving CVCs for sepsis, but this would be an artifact of documentation rather than an actual change in clinical behavior.

Another interesting finding is that while the percentage of CVCs placed emergently increased from 20% for 25%, the absolute number of CVCs placed for sepsis after day 0 also increased from 11,806 to 18,778 over the course of the study. A major contributing factor to this is likely the increased incidence of U.S. critical care admissions from the ED which rose from 1.2 to 2.2 million between 2001 and 2009 (6). However, it is notable that CVCs placed on an urgent or late basis continued to account for approximately 75% of all CVCs placed in patients admitted from the ED with a diagnosis of sepsis. It is not clear if patients who have a CVC placed for sepsis day 3 or beyond of their hospitalization – the majority throughout the study -- represent a different population than those who have CVCs placed earlier, although one hopes that the continued prevalence of late CVC insertion reflects septic patients who worsen over the course of their hospitalization rather than simply a delay in CVC placement. A reasonable hypothesis is that the relative shift from urgent to emergent CVC insertion represents earlier recognition and treatment of patients presenting with septic shock while the continued large percentage of patients with late CVC placement represents patients whose sepsis worsens in the hospital. This would be consistent with the finding that hospital mortality was noted to decrease among all groups over the course of the study, but that there was a disproportionate reduction in mortality in patients who had an emergent CVC placed, a finding consistent with findings by Walkey et al. demonstrating decreased mortality in patients with septic shock with CVC placement (7).

One limitation of the study noted by the authors is that they could not identify where emergent CVCs were placed. The mean ED length of stay for patients admitted to an ICU is 3–4 hours (6). It is possible that the increase in emergent CVC placement was due to changes in behavior in the ED as a 3–4 hour ED stay is ample time to obtain central venous access. It is equally plausible, however, that the increase in CVC placement in the first 24 hours of hospitalization occurred independent of changes in the ED and was instead due to more rapid CVC placement upon admission to the ICU.

It is likely that the number of emergent CVCs has increased since the conclusion of the study, in part due to data demonstrating decreased mortality in hospitals that participate in the Surviving Sepsis Campaign (8) or that follow quality bundles including CVC placement (9). It is likely that emergent CVC usage for severe sepsis or septic shock will continue to increase in the future in light of the recently approved measure from the National Quality Forum on severe sepsis and septic shock, which includes CVC placement (10) as well as publication of a new version of the Surviving Sepsis Campaign guidelines endorsing EGDT (11). Ensuring adequate recognition of severe sepsis and septic shock will require a broad-based effort, associated with adequate training and resources available to ED and ICU teams

to ensure that septic patients receive appropriate care in the very beginning of their hospitalization.

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