Ventilator Associated Pneumonia in Children: Current Status and Future Prospects

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Invasive mechanical ventilation (MV) is a lifesaving support system for critically sick children in emergency and Intensive care units. As per the national estimates, there were 790,257 hospitalizations with MV across all ages (except newborns) in the United States in 2005. This accounted for 2.7 episodes of mechanical ventilation per 1000 population and an estimated cost of \$27.0 billion [1]. Though MV is now used even at district level hospitals, no such estimates are available for most of the developing countries, which makes it difficult to assess the true burden of VAP. Though the reported incidence across the globe varies from 2 to 17%, a higher incidence of 38.4% is reported from the developing countries [2].

In this issue of the journal, an article by Gnanaguru et al. from Northern India evaluated the incidence, risk factors and etiological agents for VAP in children. They used CDC criteria to diagnose VAP, primarily for the uniformity and comparison of incidence with other similar studies but also used tracheal aspirate and non-bronchoscopic Bronchoalveolar lavage (BAL) fluid culture for microbiological confirmation [2].

This variability in incidence of VAP is contributed by a number of factors related to host, device and personnel in PICU [3]. In true sense, it is not appropriate to compare VAP incidence among centers unless there is uniformity with regard to the study subjects, environmental factors, infection control policy and compliance related to them. Though this study is based on a robust design, with adequate infrastructure and support services, the reported incidence of VAP is very high (38.4%).

While comparing the data with other studies, certain points need due consideration. Sample size is not large enough to do analysis for different ages (young infants and children), immune status, disease severity and different times of VAP development

(early or late). This makes the study population as heterogeneous and likely to influence the results. They used reusable, chemically disinfected, ventilator circuit and humidifier, whereas in other PICUs, Heat and moisture exchanger (HME) or disposable circuit and humidifiers are used routinely. VAP cases as per CDC criteria (but culture negative) were included in the non-VAP group for comparing the data for risk factors in VAP and Non-VAP group. But, this is also not appropriate, as this can adversely influence the results.

Reviewing annual data of ventilated children in every ICU and comparing it with its own VAP incidence of previous year may be of great help as it will help to decide preventive strategies for future reduction of VAP. Effect of infection control policy and education intervention has been shown to be effective in reducing the incidence of VAP subsequently. Study published from the same center in 2014 showed a significant reduction of VAP from 20.2 episodes per 1000 ventilation days to 14.6 episodes after the intervention [4]. However, in this study a rise in incidence to 41 episodes per 1000 ventilator days as per CDC criteria (27 episodes, microbiologically confirmed) does raise a question of sustainability of interventions.

There are issues related to the validity of definition of VAP in absence of a gold standard, though CDC criteria are used widely, wide overlap of clinical criteria with other conditions make them less sensitive and specific (http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf, 2017). Risk factors for VAP are also reported to be quite variable in different studies and one has to make its own strategy for prevention, based on their home conditions.

Gap between demand and availability of ventilator beds in pediatric intensive care unit (PICU) often leads to frequent transport, manual ventilation or ventilator care in emergency or general ward under suboptimum conditions. Repeated intubations, care during intubation and prevention of aspiration especially during unplanned intubation is often compromised, which not only make ventilation difficult but also pose a risk for infection subsequently.

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In 2016, CDC reported age adjusted definitions of VAP, based on clinical, WBC counts, and radiological criteria. Microbiological confirmation using tracheal aspirate or bronchoalveolar lavage (BAL) is desirable but not essential for the diagnosis of VAP [5]. There are few reports on the role of biological markers for the diagnosis of VAP. Levels of soluble triggering receptor expressed on myeloid cell-1 (s-TREM-1) and surfactant protein D from BAL fluid are reported to be higher in cases with VAP. Isgudar et al. showed that children with VAP had higher levels of sTREM-1, serum procalcitonin and Clinical Pulmonary Infection Score (CPIS) as compared to controls [6].

There has been a new insight into the pathogenesis of VAP and role of neutrophil activation and release of granule proteins in clearance of pathogens. IL-7 has been shown to stimulate proliferation of cells in the lymphoid lineage and plays an important role in clearance of Gram negative organisms. In animal studies, use of recombinant human IL-7 as an immunoadjuvant was found to be effective in reducing the mortality [7, 8]. Major advances in the development of vaccine against common pathogens causing VAP and lung injury, strategies to improve host defense and new bio markers for the diagnosis of VAP are likely in the near future.

Though VAP is associated with significant mortality and morbidity in children, there is no consensus with regard to diagnosis, management and prevention among centers and within the center over a period of time. As more and more centers are developing ventilation facilities, a coordinated effort to develop robust diagnostic criteria, etiological database and preventive strategy is the need of time. Looking beyond some limitations, current study is an earnest attempt in this direction. Each country should have a

central coordinating center to develop and update guidelines based on the database generated from all the centers.

Compliance with Ethical Standards

Conflict of Interest None.

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