Editorial

Real-time continuous glucose monitoring in children with critical illness - do we need it?

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Despite the tremendous improvement in the management of severe sepsis and septic shock, which are still major problems affecting millions of people around the world each year, mortality is one in four (and often more) and still increasing in incidence.[1] One of the unsolved problems until now is "should we use the tight glycemic control in pediatric sepsis and septic shock?" If the answer is yes then the second question would be "how to monitor blood glucose (BG)?" and this ultimately leads to the third question "what is the consensus about the protocol of insulin administration in this context?"

In the recent "International guidelines for management of severe sepsis and septic shock: Surviving sepsis campaign"[2] published in 2013, the recommendations for adults differ slightly from those in the pediatric consideration chapter. The recommendation suggests that hyperglycemia in septic shock and severe sepsis should be controlled using a target of ≤180 mg/dl and glucose infusion should accompany insulin therapy in newborns and children. The difference is that the level of recommendation in adults is 1A while in pediatrics it is graded 2C. This implies that the BG level should be kept at 180 mg/dl. Infants and children are at higher risk for developing hypoglycemia and a glucose intake of 4–6 mg/kg/min or maintenance fluid with dextrose 10% normal saline containing solution is advised. Children lack glycogen stores, having more insulin resistance and more patients secreting no insulin in shock situation.[3,4] The different American Associations: Clinical endocrinologists, American Heart Association, American College of Physicians and Society of Critical Care Medicine, have published different consensus targeting glycemic control between 140 and 180 mg/dl. Strangely enough, a survey of pediatric intensivists practice of "Clinical Equipoise Regarding Glycemic Control" (in 2013) of North American Pediatric Intensive Care Unit (PICUs), revealed that the published evidence does not adequately address PICU clinicians concerns.

Pediatric intensivists mostly depend on adult studies because of the small number of randomized controlled trials in pediatrics. The most famous adult study is the "Normoglycemia in Intensive Care Evaluation-Survival using Glucose Algorithm Regulation" study that revealed a slight increase in harm with hyperglycemia control, after a wide meta-analysis. Furthermore, 78% of intensivists stressed on the need for a multicenter clinical trial for BG control in pediatrics.[5]

There are three different methods used in PICU for evaluating BG: Point of care capillary blood testing, venous sampling, and real-time continuous glucose monitoring system (RT-CGMS). The authors, in this study,[6] published

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a good comparison between RT-CGMS and venous sampling BG results (as a standard method) among children with septic shock, using percutaneously inserted sensor it evaluates glucose in the interstitial fluid. There has been much criticism for the capillary method and the RT-CGMS. The internationally accepted guidelines of the Surviving Sepsis Campaign[2] explained that several factors affect the accuracy and reproducibility of point of care capillary BG, including type and model of the device used, user expertise, and patient factors: As hematocrit (false elevation in anemia), hypoxia and drugs used as catecholamines, and false elevations over the range, especially hyper and hypoglycemia range. A lot of researchers used RT-CGMS in the design of their studies.[7-11]

The author found that the RT-CGMS relative absolute difference (RAD) compare to venous samples results was 17%, another study revealed it to be 13.5% and it revealed also that RT-CGMS results meeting the "International Organization Standardization" (ISO) were 68.1% with a better accuracy in septic shock compared to severe sepsis status.[9] The author did not discuss the ISO standards.

Another study compared all three methods for BG evaluation: RT-CGMS values compared to blood gas/glucose analyzer values every 12 h and to venous BG measurement by central laboratory device as a measured reference. The RAD, strangely enough, was worse in RT-CGMS (14.4%) compared to blood gas/glucose analyzer (6.6%). Contrary to what found in this study, the percentage of matched points in the Clarke error grid zone A was 78.4% in RT-CGMS, and 98.4% in blood gas/glucose analyzer,[10] while in this study RT-CGMS matched 94.5% of readings.

The previous study[11] discussed another missed point in the present study concerning the calibration of the sensor of RT-CGMS. The study revealed that the RAD found within 6 h of sensor calibration was 8.8%, while between 6 and 12 h after calibration it was significantly high (20.1%). This also appeared in the matched points in Clarke error grid zone A to be 92.4% versus 57.5%. This indicates that RT-CGMS sensor should be calibrated <6 h, no matter what time interval is recommended by the manufacturer.

The results obtained by RT-CGMS, in the majority of the studies, is affected by situations such as edema (the percutaneous probe is used), shock (skin perfusion affected), large base deficit, therapeutic cooling as well as drug use.[8-10] This point is contrary to what stated by the author in this study.

The last observation is that this study agreed with other studies that RT-CGMS results are not accurate as regards the BG in extremes of hyper and hypoglycemia. Finally, the routine use of RT-CGMS monitoring in ICU is not yet recommended until sufficient studies on the reliability of the system are available. The most important unanswered question in this context is "Do we really need tight BG control that warrants RT-CGMS in severe sepsis and septic shock in PICU?" While certainly possible, one can conclude that the final chapter in this story has not been written.

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