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Delays in Resuscitation of the Septic Child in Indian Settings: A Clinician's Perspective

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Abstract

Severe sepsis and septic shock are the leading causes of death in children admitted to any intensive care unit of a developing country. The most important reason for unfavorable outcomes in these children is the severity of illness at presentation which makes these children refractory to any goal directed measures undertaken thereafter. Apart from the agent and host related factors, environmental factors such as delay in seeking timely and appropriate healthcare and use of inappropriate modes of transport may be equally responsible in adding to the disease severity in these children. In this article we shall briefly review the importance of early recognition and treatment and the probable reasons for delay in our set up.

Key word: Sepsis; Septic shock; Transport; Resuscitation; Golden hours; Early goal directed therapy.

Introduction

Severe sepsis and septic shock are *'the'* most important causes of mortality in emergency and intensive care units of most resource limited countries. While the mortality rates reported with septic shock from developed countries is 50%, it is 40-67% in children form developing countries (1,2). Despite the best resuscitative efforts in the first 6 hours (*ongoing study*) a major proportion of these children die every year. The most important reason for unfavorable outcomes in these children is increased severity at presentation due to delay in seeking timely and appropriate healthcare. The importance of early recognition and treatment and the probable reasons for delay in our set up are briefly discussed here.

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Early goal directed therapy in septic shock

A cascade of clinical, hemodynamic and metabolic changes occur in septic shock, which if not identified early and managed appropriately could result in irreversible multi-organ damage. The first hours following the diagnosis of severe sepsis and septic shock are known as the "golden hours" as it is during this period that aggressive hemodynamic resuscitation has been shown to be associated with higher survival rates and improved organ dysfunctions (3, 4). The lack of rapid restoration of adequate microcirculation triggers a cascade of inflammation and disseminated micro thrombosis for which, no effective treatment is available at present. Inadequate early resuscitation results in multiple organ system failure and in death days to weeks after the initial presentation (5). This has been confirmed by a recent meta-analysis that suggested that aggressive resuscitation efforts that begin early (before the onset of organ failure) may prove more beneficial than resuscitation carried out after the establishment of organ failure (6). After the "golden hours", aggressive hemodynamic resuscitation is no longer effective in restoring organ function or in decreasing mortality (6). Goal directed resuscitation in these golden hours has been the target of several adult and

few pediatric studies including an ongoing trial in our ICU (3,7, 8, 9).

Early goal-directed therapy (EGDT) is a research innovation that has been shown to reduce mortality in adults with severe sepsis and septic shock (3). EGDT is simply a protocol derived from components that have long been recommended as standard care for the septic patient. EGDT involves adjustments of cardiac preload, after load, and contractility to balance oxygen delivery with oxygen demand which in turn is important for early hemodynamic optimization. The protocol is initiated as soon as sepsis induced hypo-perfusion is identified and it targets specific end points of resuscitation derived from hemodynamic monitoring (central venous pressure [CVP], mean arterial pressure [MAP], and central venous oxygen saturation [$Scvo_2$] (3, 10). Current consensus recommendations now advocate EGDT as best practice for the first 6 hour resuscitation in severe sepsis in adults. The EGDT protocol has been modified and advocated for pediatric septic shock in the "surviving sepsis campaign guidelines" (SSSG) with similar resuscitation end points like $Scvo_2$ >70 %, decreased lactate, urine output of > 1ml/kg/hr, CRT<2 sec, normal mental status and normal pulses with no difference between peripheral and central pulses (11). A detailed review of the SSCG 2008 is available in an earlier issue of this journal (volume 3, number 2) (12).

In the first study on EGDT by Rivers et al (8) of 263 adult patients, EGDT was associated with a 16% absolute risk reduction for in-hospital mortality, which to date is the largest mortality benefit demonstrated in septic shock. Following this the outcome benefit has been replicated in 19 before-and-after adult studies of 1,677 pre-implementation and 2,361 post-implementation adult patients and a randomized pediatric trial in the last decade (12). In the pediatric study by Oliviera et al (13) there was an 82% reduction in mortality risk in the intervention group. In the ongoing study in our ICU wherein more than half the calculated sample size has been recruited we have also found a trend towards decreased mortality rates in the group in which intermittent monitoring of $Scvo_2$ is done as part of EGDT protocol (mortality 34% vs. 57% in the $Scvo_2$ vs. no $Scvo_2$ group respectively). Although the mortality rates due to septic shock have declined in our unit with the implementation of the EGDT protocol the overall mortality rate of the study population is still 45% which is much higher in comparison to figures from the developed countries. When we tried to analyze the factors associated with unfavorable outcome in the study patients we found the time to hospitalization and the duration of illness to be two of the important factors associated with poor outcomes in these patients (*unpublished data*).

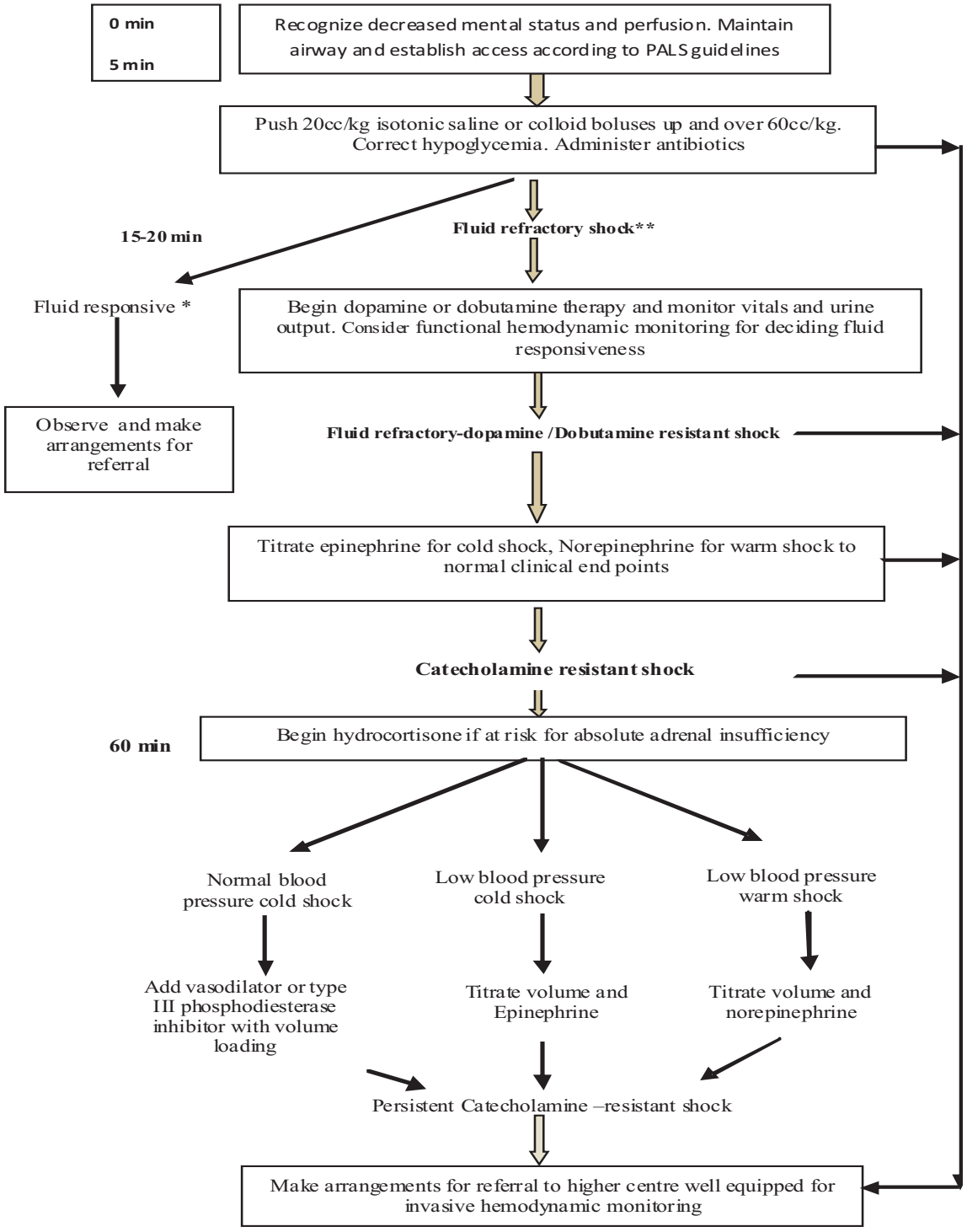
Reasons for delay in resuscitation of the septic child

The major reasons for loss of 'golden hours' in our country may be due to the three major delays: delay in recognition of shock, delay in transport of the affected child and delay in initiating appropriate treatment. The result is that the patient often reaches the tertiary care center in the late stages of septic shock wherein end organ failure has already started to set in (13).

Delay in recognition could be due to lack of knowledge and awareness in the treating pediatricians and physicians of the markers of tissue perfusion. In most circumstances clinical assessment at primary contact is based on appearance and activity of the child and measurement of blood pressure only. If the blood pressure is normal which is often the case, the physicians are in no hurry to resuscitate the child thereby defeating the purpose of early goal directed therapy.

Septic shock can be identified by clinical variables, hemodynamic variables, oxygen use variables, or cellular variables. The clinical diagnosis of early septic shock is possible with presence of the following in a setting of suspected infection: hypothermia or hyperthermia along with clinical signs of decreased perfusion, including decreased

mental status, prolonged capillary refill time of > 2 seconds or flash capillary refill, diminished or bounding peripheral pulses, mottled cool extremities, or decreased urine output of < 1ml/kg/hr. Blood pressure, a hemodynamic variable, drops only in late shock and should not be relied on to make the diagnosis; however, its presence in a child with clinical suspicion of infection is confirmatory (5, 14). The shock may further be classified as cold shock which is characterized by decreased perfusion including decreased mental status, decreased urine output,



capillary refill > 2 sec, diminished peripheral pulses and mottled cool extremities and warm shock characterized by decreased perfusion including decreased mental status, decreased urine output, and flash capillary refill and bounding peripheral pulses (5, 14). It is important to create awareness about utility of these clinical parameters among pediatricians so that septic shock is suspected early and the patient is either managed appropriately or provided initial care and transported to appropriate centers.

The second and major cause of unavoidable delay is due to poor availability of transport facilities from rural areas and outskirts to the tertiary care centers. Patients often reach the appropriate centers by train, auto rickshaw, taxi, buses or other locally available transport facilities without any monitoring. This leads to further deterioration of the hemodynamic status. Therefore, the role of the pediatrician (who suspects septic shock in a child and decides to send him to a higher center) includes initial aggressive management (figure 1) with arrangement of proper transport with facilities for monitoring during transport by reasonably trained person. Transport is often the key element in deciding the outcomes as it is often observed that even relatively stable patients may deteriorate while being moved for investigations, procedures etc.

The third and important cause of avoidable delay is delay in initiating treatment which may be due to delay in recognition, non-availability of life saving drugs or lack of expertise in resuscitating a child with septic shock in the peripheral health centers. To overcome these problems there is need for development of human resources by organizing short term training courses, workshops and other educational activities by experts; for pediatricians, intensive care nurses and other staff.

A modified protocol of the SSCG guidelines to guide the community physicians in management of septic shock is depicted in figure 1.

Conclusion

In conclusion we would like to quote the famous poet of all time 'Robert Frost' who once said "Miles to go before I sleep' in the context of reducing mortality rates due to septic shock in our country. A consolidated effort at all levels of health care targeting this group of children who can be salvaged with timely help needs to be taken from our side so as to reduce the *pathos* caused by this disease in our country. There is also a need to generate evidence for better management of children with septic shock in our country. There is need to do operational research especially with regard to addressing our local problems of missed diagnosis, reasons for delayed reporting, problems of transportation, etc.

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