Research Article

Cardiac Dysfunction and Serum Ferritin Level as Early Prognostic Markers in Children With Sepsis

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Abstract
Introduction: Sepsis is a life threatening condition which affects many children, Sepsis is said to be one of the leading causes of death among children even in advanced countries. **Aim of the work:** to verify the association between cardiac dysfunction and serum ferritin level with unfavorable outcomes in pediatric sepsis. **Patients and Methods:** This prospective cohort study was carried out on 40 patients with suspected or confirmed sepsis in our PICU. All patients in the study were subjected for assay of serum levels of ferritin, CRP and echocardiography on Day of admission & Day 3. **Results**: Serum Ferritin level was significantly higher among cases with cardiac dysfunction than cases without cardiac dysfunction. There was highly statistically significant difference between day of admission D1 and third day as regard to serum ferritin level and CRP with median value of Ferritin level and CRP were higher on the day of admission compared to third day.
Key Words: Sepsis, Serum ferritin, Cardiac dysfunction, outcome.

Introduction
Sepsis is a life threatening condition which affects many children, Sepsis is said to be one of the leading causes of death among children even in advanced countries (Watson et al., 2003).. Finding tools that can anticipate or monitor unfavorable evolution in sepsis can contribute to the improvement of care in these critically ill patients (Simon et al., 2004), in pediatric sepsis, myocardial dysfunction is one of the main causes of clinical deterioration (Smeding el al., 2012).

Patients and Methods: Design:
prospective cohort study.

Setting:
pediatric Intensive Care Unit (PICU) – Minia University Hospital for Gynecology, Obstetrics and Pediatrics.

Participants:
40 patients; they were recruited during the period from September 2019 to April 2020 at pediatric intensive care unit.

Intervention:
In august 2019 a strategy introduced to verify the association between cardiac dysfunction and serum ferritin level with unfavorable outcomes in pediatric sepsis, Demographic data and laboratory data collected, recorded and analyzed for children with sepsis during study term. All patients in the study were subjected for assay of serum levels of ferritin, CRP and echocardiography on Day of admission & Day 3.

Inclusion criteria
Admission at pediatric intensive care unit, Pediatric patients aged from 1 month to 16 years, Who have clinical diagnosis or suspicion of sepsis, Patients would need cardiovascular support, Patients would need mechanical ventilation.

Exclusion criteria
Congenital heart disease, Presence of confirmed or suspected endocrine disease involving the somatotropic and corticotropic axes, Need for hemofiltration or any other renal replacement therapy, Diagnosis of congenital or acquired immunosuppression, Confirmed or suspected congenital glucose metabolism alterations, severe liver impairment.

Results
Fever was the most common presenting complaint among studied cases followed by tachypnea. The diagnoses of the studied cases were three main categories: pneumonia, central

nervous system infection and Gastro-enteritis, the etiology of increase the risk of pneumonia may include environmental factors, genetic susceptibility, and ethnic causes.

There was highly statistically significant difference between day of admission D1 and third day as regard to C-reactive protein with median value of CRP was higher on the day of admission compared to third day. There was highly statistically significant difference between day of admission D1 and third day as regard to serum ferritin level with median value of Ferritin level was higher on the day of admission compared to third day.

Serum Ferritin level was significantly higher among non-survivor's septic cases than survivor's septic cases. Cardiac dysfunction (EF<55%) was present among 47.5% of the studied cases. Ejection fraction% was significantly lower among non-survivors than survivors septic. Number of cases died with cardiac dysfunction was higher than that with no cardiac dysfunction.

Serum Ferritin level was significantly higher among cases with cardiac dysfunction than cases without cardiac dysfunction. There were statistically significant positive correlations between serum ferritin level at day of admission and Capillary refill time, ALT, PT, and Creatinine. There were statistically significant positive correlations between serum ferritin level on day of admission and duration of Mechanical ventilator (hrs) value, duration of inotropes (hrs) and maximum inotropic score, While there was no statistically significant correlation between serum ferritin level on admission and duration of PICU admission (days).

There was significant difference between cases with cardiac dysfunction and those without cardiac dysfunction as regard to duration of mechanical ventilation (hr.), duration of inotropes (hr.) and maximum inotropic score while there was no statistically significant difference between cases with cardiac dys-function and those without cardiac dysfunction as regard to duration of PICU admission (days).

The mortality rate was 60% among cases. Factors found to be significantly associated with mortality by univariable analysis were

entered the multivariable model to detect the significant predictors of mortality, cardiac dysfunction and serum ferritin were found to be predictors of mortality. Patients with cardiac dysfunction were more likely to die than patients without cardiac dysfunction), the increase in serum ferritin was associated with increase in the odds of child to die.

Discussion
The study showing that fever is the most common presenting complaint among studied cases (70%), followed by tachypnea (dyspnea) (45%), This agrees with (Goldstein et al., 2005) they found that fever is the most common presenting complaint of children with sepsis, On the other hand (Krotz et al., 2017) found that tachypnea was the most common presenting symptom (81.5%), and followed by fever (70.9%).

The diagnoses of the studied cases were three main categories: pneumonia (50%), central nervous system (CNS) infection (30%) and Gastro-enteritis (20%). The etiology of increase the risk of pneumonia may include environmental factors, genetic susceptibility, and ethnic causes (El-Kinany et al., 2018).In this respect (Weiss et al., 2014) found that the most frequent site of infection was respiratory system with pneumonia (40%), On the other hand (Randolph and Mc Culloh 2014), found that diarrheal diseases are the major cause of sepsis in children, especially in the underdeveloped countries

This present study showed that, there was highly statistically significant difference between day of admission D1 and third day as regard to C-reactive protein with median value of CRP was higher on the day of admission 48 mg/L (24-104) compared to third day that was 24 mg/L (12-48) with P value <0.001. Also (Tonial et al., 2017) found that CRP levels were extremely high on admission and decreased significantly.

Our study showed that, there was highly statistically significant difference between day of admission D1 and third day as regard to serum ferritin level with median value of Ferritin level was higher on the day of admission 522 ng/ml (395-652) compared to third day that was 400 ng/ml (335.5-562) with P

value <0.001. In contrast to the study of (Tonial et al., 2017) who found no significant decrease in serum Ferritin level on third day of admission.

In the current study we found that, median value of Ferritin level was significantly higher among non survivors septic cases 565 ng/ml (453.5-769.5) than survivors septic cases 456.5 ng/ml (347.5-539) with p value = 0.021 . This result agrees with (Bennett et al., 2011) who found that very high serum ferritin levels are associated with high mortality in pediatric intensive care patients.

The current study showed that, median value of Ejection fraction% was significantly lower among non-survivors 44 % (36.5-55.5) than survivors septic cases 60 % (58.5-65.5) with P value <0.001. This comes in agreement with (Elgazzar et al., 2018) whose study carried out on 50 pediatric patients with septic shock and found decreased EF% was higher among died than improved septic cases.

Our study showed that, the mortality rate was 60%. This was higher than (El-Kinany et al., 2018) who found the mortality rate was 52.5%.

Conclusion & Recommendations
Serum ferritin level, CRP and echocardiographic findings are reliable prognostic markers in detecting outcome of children with sepsis. Cardiac dysfunction by echocardiogram and hyperferritinemia on day of admission in pediatric patients with sepsis are significantly associated with unfavorable outcomes.

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