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Cortisol Levels Exhibited No Momentous Variations Between Bacterial and Non-Bacterial Neonatal Meningitis in Spite of Affecting the Outcome

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Abstract

Background: Neonatal bacterial meningitis and its complications are considerably recuperated by adjunctive treatment with corticosteroids. However, in those neonates, the cortisol level is not well recognized. The aim of this study was to investigate cortisol levels in neonates with bacterial meningitis and comparing the outcomes with those without bacterial meningitis.
Methods: In the study, thirty consecutive neonates with bacterial meningitis were used and a group of 30 neonates with non-bacterial meningitis were considered for comparison.
Results: Regarding serum cortisol (μg/dL), no statistically significant difference was found in bacterial (9.9 ± 0.4) and non-bacterial meningitis (10.3 ± 1.3) neonates ($P = 0.112$), but neonates with lower level of cortisol had a poor outcome.
Conclusions: Cortisol levels showed no significant differences between bacterial and non-bacterial meningitis but it affected the outcome.

Keywords: Corticosteroids, Meningitis, Bacteria, Neonate

1. Background

Neonatal infections, expressly bacterial meningitis is a grim and fatal disorder with long term morbidity like cerebral palsy and hearing impairment (1). Antimicrobial management is essential for bacterial meningitis and thwarts the complications. Therefore, early distinguish of bacterial meningitis from non-bacterial one is indispensable; especially since the presentations are habitually similar (2). Using several indicators in blood and also in cerebrospinal fluid has been proposed to recuperate determining the etiology (3).

It is known that the pathological alterations and its complications are an upshot of embroidered immune responses to the inflammation which is arisen in the brain. The inflammation which disturbs the brain is continuously associated with the production of markers such as tumor necrosis factor (4). As the pro-inflammatory mediators present a vital part in the pathological conversions of bacterial meningitis, their modulation is important to manage the disease (5). Several studies exhibited that glucocorticoids play an effective role in the management of meningitis caused by *Haemophilus influenzae* in infants and, a beneficial effect of systemic administration of dexamethasone was acknowledged in cases with meningitis caused by *Streptococcus pneumoniae* (6).

Although glucocorticoids can decrease the long-term morbidity of bacterial meningitis, the function of mediators, like interleukins and cortisol, in Cerebrospinal fluid (CSF) through the progress of the illness is not well known (7). Cortisol is comparable to interleukin 10 and augmented serum cortisol levels have been identified in some studies on infants and children with complicated bacterial meningitis, and it is found that a higher cortisol level is concomitant with bad consequences and long-term morbidity (8).

2. Objectives

The aim of this study was therefore to investigate cortisol levels in neonatal meningitis and comparing it with the outcome in those without bacterial meningitis.

3. Methods

This prospective study was done at Suez Canal university hospital, Ismailia, Egypt, from March 2012 to November 2012. Ethical practices were followed according to declaration of Helsinki and informed consents were attained from the parents. During the study period, 75 neonates admitted with the confirmed meningitis, were admitted to

the isolation room of a tertiary neonatal intensive care unit (NICU), of whom 60 newborn infants were selected. Some infants were excluded due to antibiotic treatment before entrance or glucocorticoids consumption before admission. Demographic data of the studied neonates is shown in Table 1. The inclusion criteria were the age less than 30 days with manifestation of meningitis, and positive lumbar puncture, and a bacterial cause confirmed by positive cultures.

White blood cell counts were determined using clinical analyzer Coulter. Serum C-reactive protein levels were gaged using a nephelometer, with normal level which was less than 6 mg/ml. The concentration of cortisol was done by radioimmunometric assay.

Statistical analyses were performed using SPSS. Records are offered as mean and standard deviation also range and median.

4. Results

4.1. Demographic and Clinical Data

No statistical difference was found between both groups (Table 1).

4.2. Clinical Sequence and Cause of Bacterial Meningitis

Six neonates with bacterial meningitis were admitted with shock which was septic in nature at the time of admission. The bacterial meningitis was diagnosed in 30 neonates. Out of them, 14 cases were triggered by *Neisseria meningitidis* and in 11 cases by *Streptococcus pneumoniae*. Other recognized bacteria were *Staphylococcus aureus* (one case), *Escherichia coli* (one case), *Listeria monocytogenes* (one case) and *Haemophilus influenzae* (two cases).

4.3. Cerebrospinal Fluid Finding

Chemical characters in the bacterial meningitis group is shown in Table 2.

4.4. Cortisol in Serum

No statistically significant differences in cortisol levels were found between bacterial and non-bacterial meningitis groups (Table 3). But serum cortisol levels were markedly decreased in the neonates with poor outcome (Table 4).

5. Discussion

We scrutinized the hypothesis that cortisol levels would be raised in neonates with meningitis as this is naturally inflammatory and cause stressful condition to the neonates.

In discordance with our hypothesis, serum cortisol levels were not significantly increased in neonates with bacterial meningitis than those with non-bacterial meningitis. Our results did not disclose the elevated serum cortisol levels, but not like the previously study with the inflammatory reaction (9).

There was a higher concentration in neonates with meningococcal meningitis compared with those with severe meningococcal sepsis. In contrast, we perceived a significant association between the low serum cortisol levels and a cruel outcome of bacterial meningitis like the cases with critical sepsis which is associated with a dull cortisol response (10).

The increased cortisol levels were reported in several central nervous system (CNS) disorders, but in CSF (11), still, the cortisol levels were not greater in the neonates with meningitis caused by bacteria group, while meningitis is connected to the systemic inflammatory course, severe stress response and distorted blood-brain barrier (9). Former studies have approved that CSF cortisol levels cannot be computed truthfully from serum levels and equilibrium between cortisol levels in serum and CSF is operated by effective efflux from the brain (12) and cortisol can be metabolized by 11β-hydroxysteroid dehydrogenase in the brain, upheld by the expanse of free cortisol thru sepsis (13).

Zysk et al. (14) recounted that dexamethasone can multiply neuronal cell passing in the hippocampus and dexamethasone lessened whole neuronal mutilation. Cortisol can also diminish production of reactive oxygen with a significant relation with CSF levels of cortisol and lactate in pneumococcal meningitis (15).

Serum cortisol does not differ in bacterial meningitis from non-bacterial meningitis, but neonates with low level of cortisol had a poor outcome which may interpret by the fact that neonates with critical condition may have temporary adrenal insufficiency (16, 17).

To conclude; cortisol levels exhibited no momentous variations between bacterial and non-bacterial meningitis, in spite of affecting the outcome as neonates with lower cortisol level had a higher mortality rate.

Table 1. Demographic and Clinical Data of Both Groups

Parameter	Bacterial Meningitis Neonates (n = 30)	Non-Bacterial Meningitis Neonates (n = 30)	P Value
Sex (male/female)	19/11	17/13	0.071
Age (days; mean ± SD)	16 ± 4	15 ± 3	0.278
gestational age (in weeks; mean ± SD)	38.3 ± 0.3	38.6 ± 0.9	0.089
Weigh at birth (in grams; mean ± SD)	3290 ± 165	3350 ± 210	0.224

Table 2. Parameters in Blood and CSF in Neonates With Bacterial Meningitis

Parameters	Bacterial Meningitis Neonates (n = 30)
Blood	
WBC count, cells/mm^3	13,700 (9,700 - 22,200)
CRP, mg/L	150 (30 - 200)
CSF	
WBC count, cells/mm^3	1,072 (300 - 1,443)
Neutrophil count cells/mm^3	700 (254 - 1,440)
Protein, g/L	2.0 (1.3 - 4.3)
Glucose mmol/L	0.9 (0.5 - 2.5)

Table 3. Comparison of Cortisol Between Bacterial and Non-Bacterial Meningitis

Parameter	Bacterial Meningitis Neonates (n = 30)	Non-Bacterial Meningitis Neonates (n = 30)	P Value
Cortisol, μg/dL	9.9 ± 0.4	10.3 ± 1.3	0.112

Table 4. Cortisol Level and the Outcome

Parameter	Discharged Alive (n = 42)	Died (n = 18)	P Value
Cortisol, μg/dL	11.5 ± 1.3	5.3 ± 0.9	< 0.05

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