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# Concentrations of procalcitonin and C-reactive protein, white blood cell count, and the immature-to-total neutrophil ratio in the blood of neonates with nosocomial infections: Gram-negative bacilli vs coagulase-negative staphylococci

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Title: Concentrations of procalcitonin and C-reactive protein, white blood cell count, and the immature-to-total neutrophil ratio in the blood of neonates with nosocomial infections: Gram-negative bacilli vs coagulase-negative staphylococci

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Abstract: This study was undertaken to determine whether concentrations of procalcitonin in the blood of neonates with nosocomial infections depend on the type of pathogen. Qualification to the study group was based on the clinical signs of infection. We found that infections with Gram-positive (chiefly coagulase-negative staphylococci) and Gram-negative bacteria are accompanied by elevated concentrations of procalcitonin. In the case of Gram-positive bacteria, other laboratory signs of infection studied by us (concentration of C-reactive protein, white blood cell count, immature-to-total neutrophil ratio) were not discriminatory, confirming the diagnostic usefulness of procalcitonin measurements in nosocomial infections of the neonate with Gram-negative or Gram-positive bacteria.

Dear Reviewer,

I am grateful for critical comments and careful review of my manuscript.

Ad. Major comments:

Re. 1. The manuscript has been revised by a native English speaker.

Re. 2. Infections caused by Gram-negative bacteria are known for significant abnormalities in laboratory tests, such as increased concentrations of PCT and CRP, WBC and I:T neutrophil ratio. The situation is different in the case of infections caused by CoNS. The essential finding of the present study is that neonates with sepsis caused by Gram-positive bacteria (chiefly CoNS) differ from uninfected neonates only in PCT, and not CRP, WBC or the I:T neutrophil ratio. This information is very important for the clinician dealing with sepsis caused by CoNS, which have a meagre symptomatology and present without characteristic laboratory findings, apart from positive blood cultures requiring a few days to obtain.

In the present study, PCT concentration in Gram(-) sepsis, Gram(+) sepsis, and uninfected controls was (median values) 9.15 ng/mL, 4.2 ng/mL, and 0.94 ng/mL, respectively.

Re. 3. The term „nosocomial infection” has been supplemented by “late-onset infection” used by neonatologists, as opposed to „early-onset infection” signifying inborn infection.

Re. 4. This part of the manuscript has been revised as suggested by the reviewer.

“Designation of infection status.

All newborns were examined by the neonatologist as frequently as required, at least once a day. Late onset neonatal infection was recognized basing on the presence of three or more of the following five categories of clinical signs: 1. skin color (pallor, jaundice, cyanosis); 2. respiratory function (apnea, tachypnea >60/min, grunting, nasal flaring, intercostal or sternal retractions, need for high ventilator settings or oxygen); 3. cardiovascular function (brady/tachycardia, poor peripheral perfusion, hypotension); 4. neurologic findings (hypotonia, irritability, lethargy, seizures); 5. gastrointestinal function (abdominal distension, green or bloody residuals, vomiting; temperature instability), and positive peripheral blood culture. Nosocomial infection was diagnosed when symptoms appeared after three days of life.

Other investigations performed when clinically indicated included chest or abdominal radiographs, urine and spinal fluid microscopy and culture, tracheal aspirate culture and cultures from superficial sites. In addition, standard laboratory biochemical tests (eg. glucose and protein levels) and visual examinations were assessed.

Laboratory tests routinely performed in the management of infection included C-reactive protein levels (CRP values > 5 mg/L in neonate’s venous blood were considered abnormal), white blood cell count with differential (WBC > 15 or < 5 G/L were considered abnormal), platelet count (Plt < 100 G/L were considered abnormal), and the immature to total neutrophil ratio (I:T ratio > 0.2 were considered abnormal).”

Complying with the editorial rules for a short communication, I decided not to elaborate on the designation of infection status.

Re. 5. This part of the manuscript has been revised as suggested by the reviewer.

Ad. Minor comments

Re. 1. Full spelling of abbreviations is now provided.

Re. 2. Informed consent was obtained from the parents.

Re. 3. The tests were done in group A at the onset of infection (mean:  $17 \pm 12$  days of life) and after three days of life (mean:  $26 \pm 19$  days) in group B (control).

Re. 4. The distribution curves for PCT and CRP deviated significantly from normal. Therefore, median, minimal and maximal values were used for comparison of the groups. The revised version provides mean and standard deviation values as suggested by the reviewer.

With best regards  
Agnieszka Kordek

1  
2 Nosocomial infections (late-onset infections) in neonates remain a serious problem at  
3 neonatal intensive care units [1], with an incidence rate of 17-25% [2] and mortality of 17-  
4 72% depending on the gestational age of the neonate and etiology of the infection [3]. It has  
5 been demonstrated that bacterial infections are accompanied by increased procalcitonin (PCT)  
6 concentrations [4, 5]. The present work was undertaken to determine whether PCT  
7 concentrations in neonates with nosocomial infections vary with pathogen type (Gram-  
8 negative bacilli vs coagulase-negative staphylococci (CoNS)). The study was conducted at the  
9 Department of Obstetrics and Perinatology, Pomeranian Medical University, the study  
10 protocol was approved by the local bioethics committee, and informed consent was obtained  
11 from the parents.  
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14 The study group (group A; gestational age  $29.7 \pm 3.7$  weeks; body mass  $1264 \pm 574$  g)  
15 included 52 neonates with nosocomial infection diagnosed by an experienced neonatologist  
16 on the basis of typical symptoms and laboratory findings.  
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19 Late onset neonatal infection was recognized basing on the presence of three or more  
20 of the following five categories of clinical signs: 1. skin color (pallor, jaundice, cyanosis); 2.  
21 respiratory function (apnea, tachypnea  $>60/\text{min}$ , grunting, nasal flaring, intercostal or sternal  
22 retractions, need for high ventilator settings or oxygen); 3. cardiovascular function  
23 (brady/tachycardia, poor peripheral perfusion, hypotension); 4. neurologic findings  
24 (hypotonia, irritability, lethargy, seizures); 5. gastrointestinal function (abdominal distension,  
25 green or bloody residuals, vomiting; temperature instability), and positive peripheral blood  
26 culture. Nosocomial infection was diagnosed when symptoms appeared after three days of  
27 life.  
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30 Laboratory tests routinely performed in the management of infection included C-  
31 reactive protein levels (CRP values  $> 5$  mg/L in neonate's venous blood were considered  
32 abnormal), white blood cell count with differential (WBC  $> 15$  or  $< 5$  G/L were considered  
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1 abnormal), platelet count (Plt < 100 G/L were considered abnormal), and the immature to  
2 total neutrophil ratio (I:T ratio > 0.2 were considered abnormal).  
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4 Venous blood in group A was obtained at the onset of clinical symptoms of infection  
5 (mean age of neonate  $17 \pm 12$  days). We performed cultures to determine the type of pathogen  
6 and measured concentrations of PCT and C-reactive protein (CRP), white blood cell (WBC)  
7 count, and the immature-to-total (I:T) neutrophil ratio. The control group (group B;  
8 gestational age  $30.0 \pm 5.1$  wks; body mass  $1502 \pm 950$  g) included 88 neonates without  
9 infection past the third day of life.  
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18 Groups were compared with the Mann-Whitney non-parametric U test. The Shapiro-  
19 Wilk W test revealed significant deviation from normal distribution in the case of PCT and  
20 CRP. Consequently, descriptive statistics for both parameters relied on median, minimal, and  
21 maximal values (it was also shown mean and standard deviation values). The level of  
22 significance was taken as  $p = 0.05$ .  
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31 Positive blood cultures were obtained in 34 (65.4%) of infected neonates. Gram-  
32 negative bacteria were cultured in 22 neonates (multi-resistant hospital strains of *Klebsiella*  
33 sp. ESBL(+) (n=12), *Pseudomonas aeruginosa* MBL (n=1), *Enterobacter* sp. AmpC,  
34 ESBL(+) (n=5), *Serratia* sp. (n=3), and *Citrobacter freundii* (n=1)). Gram-positive bacteria  
35 were revealed in 8 neonates (coagulase-negative, methicillin-resistant (MR) skin and  
36 hemolytic strains (n=7), *Staphylococcus aureus* MR (n=1)) and *Candida* in 4 neonates.  
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46 PCT and CRP concentrations in group A and B differed significantly (PCT median  
47 (min.-max.): 4.3 (0.25-168.53) ng/mL vs 0.94 (0.20-35.05) ng/mL,  $p = 0.000001$ ; CRP  
48 median (min.-max.): 20.30 (0.1-199.7) mg/L vs 2.7 (0.10-57.0) mg/L,  $p=0.000005$ ,  
49 respectively). No significant differences between groups were found for WBC and the I:T  
50 neutrophil ratio. Infection by Gram-negative bacteria lead to highly significant increases in  
51 the concentration of PCT and CRP, as well as in WBC and the I:T neutrophil ratio. PCT and  
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1 CRP were also significantly higher for Gram-negative than Gram-positive bacteria. Infection  
2 by Gram-positive bacteria produced elevated PCT concentrations ( $p = 0.011$ ) and no  
3 significant change in CRP (Table 1). PCT concentrations in sepsis caused by *Candida* sp.  
4 differed from those in the control group B ( $p = 0.029$ ) but no conclusions could be drawn due  
5 to the small number ( $N = 4$ ) of *Candida* infections.  
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11 Our observation that PCT concentrations are elevated in nosocomial infections (late-  
12 onset neonatal infections) regardless of the type of pathogen agrees with the report of Franz et  
13 al. [4]. What is important, PCT was the only parameter measured by us which was elevated in  
14 sepsis caused by Gram-positive bacteria. Therefore, CRP concentration, WBC count, and the  
15 I:T neutrophil ratio cannot serve to disclose Gram-positive infections. These findings are in  
16 agreement with the observations of Kawczyński and Polakowska [5]. Chiesa et al. [6]  
17 reported on the low sensitivity of CRP and lower PCT levels in sepsis caused by CoNS as  
18 compared with Gram-negative bacteria. Pourcyrous et al. [7] did not find elevated CRP  
19 concentrations in neonates with positive blood cultures for *Staphylococcus epidermidis*,  
20 confirming other reports on the relatively low pathogenicity of this species [8].  
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36 The usefulness of PCT for the early diagnosis of sepsis caused by CoNS gains  
37 importance in view of the significant and rising contribution of these pathogens to the  
38 etiology of nosocomial infections in the neonate. Treatment at intensive care units often  
39 requires cannulation of blood vessels and other invasive procedures which facilitate infection  
40 by *Staphylococcus epidermidis* known to adhere to silicon and form a protective coat  
41 composed of mucopolysaccharides, which shields this pathogen from the immune system of  
42 the organism and blocks the entry of drugs (antibiotics). Until recently, positive blood cultures  
43 for CoNS were regarded as contamination during collection of the sample. Contamination is  
44 more likely in term neonates and older infants. However, in neonates with very low birth  
45 weight, the detection of this pathogen in culture usually reflects true bacteremia. According to  
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Freeman et al. [9], bacteremia caused by CoNS has a late onset (mean age at detection was 20 days). Even though this pathogen is not responsible for increased mortality, CoNS infection prolongs treatment with antibiotics and hospital stay by approximately 12 days and 2.5 weeks, respectively. It is also worth noting that CoNS are the cause of the greatest number of late sepsis in neonates [3, 10].

In conclusion, elevated concentrations of PCT in venous blood may prove particularly helpful for the diagnosis of nosocomial infections of the neonate with Gram-positive bacteria (chiefly CoNS).

#### References:

1. Brady MT (2005) Health care – associated infections in the neonatal intensive care unit. *Am J Infect Control* 33:268-275.
2. Polin RA, Saiman L (2003) Nosocomial infections in the neonatal intensive care unit. *NeoReviews* 4:81–89.
3. Stoll BJ, Hansen N, Fanaroff AA, et al. (2002) Late-onset sepsis in very-low-birth-weight neonates: the experience of the National Institute of Child Health and Human Development Neonatal Research Network. *Pediatrics* 110:285–291.
4. Franz AR, Kron M, Pohlandt F, Steinbach G (1999) Comparison of procalcitonin with interleukin-8, C-reactive protein and differential white blood cell count for the early diagnosis of bacterial infections in newborn infants. *Pediatr Infect Dis J* 18:666–671.
5. Kawczyński P, Polakowska E (2004) Plasma levels of C-reactive protein, procalcitonin, interleukin-6 and interleukin-10 in preterm neonates evaluated for nosocomial sepsis. *Med Sci Monit* 10, Suppl. 2:58–61.
6. Chiesa C, Pacifico L, Rossi N, et al. (2000) Procalcitonin as a marker of nosocomial infections in the neonatal intensive care unit. *Intensive Care Med* 26:175–177.



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7. Pourcyrous M, Bada HS, Korones SB, et al. (1993) Significance of serial C-reactive protein responses in neonatal infection and other disorders. *Pediatrics* 92:431–435.
8. Benjamin DK, DeLong E, Cotten CM, et al. (2004) Mortality following blood culture in premature infants: increased with Gram-negative bacteremia and candidemia, but not Gram-positive bacteremia. *J Perinatol* 24:175–180.
9. Freeman J, Epstein MF (1990) Extra hospital stay and antibiotic usage with nosocomial coagulase-negative staphylococcal bacteriemia in two neonatal intensive care unit populations. *Am J Dis Child* 144:324-329.
10. Fendler WM, Piotrowski AJ (2008) Procalcitonin in the early diagnosis of nosocomial sepsis in preterm neonates. *J Paediatr Child Health* 44:114-118.

Table 1. PCT, CRP, WBC and I:T neutrophil ratio values in the blood of neonates with nosocomial infections (A) and in uninfected neonates (B)

Parameter	1	2	p 1 vs 2	3	p 1 vs 3	p 2 vs 3
	Group A Gram-negative bacteria N = 22	Group A Gram-positive bacteria N = 8		Control group B N = 88		
PCT (ng/mL)	9.15 (0.61– 168.53) 41.22 ± 57.25	4.20 (1.57–5.66) 3.81 ± 2.07	<b>0.019</b>	0.94 (0.20–35.05) 1.82 ± 3.87	<b>0.00034</b>	<b>0.011</b>
CRP (mg/L)	52.85 (4.10–199.70) 61.83 ± 49.29	4.50 (2.30–25.0) 9.72 ± 9.69	<b>0.026</b>	2.7 (0.10–57.0) 4.98 ± 8.85	<b>0.000003</b>	0.283
WBC (x10 <sup>9</sup> /L)	15.40 (2.90–49.0) 22.96 ± 15.26	11.55 (6.10–28.70) 12.28 ± 8.15	0.097	10.0 (5.0–24.0) 10.92 ± 3.82	<b>0.007</b>	0.975
I:T neutrophil ratio	0.46 (0.30–0.71) 0.48 ± 0.18	0.40 (0.33–0.47) 0.40 ± 0.10	0.423	0.12 (0.04–0.30) 0.14 ± 0.09	<b>0.005</b>	0.059

Median, min.–max./ X ± SD

Table 1. PCT, CRP, WBC and I:T neutrophil ratio values in the blood of neonates with nosocomial infection (A) and in uninfected neonates (B) depending on the etiology of sepsis: Gram-negative vs Gram-positive bacteria

Parameter	1	2	p 1 vs 2	3	p 1 vs 3	p 2 vs 3
	Sepsis Gram-negative bacteria N = 22	Sepsis Gram-positive bacteria N = 8		Control group B N = 88		
PCT (ng/mL)	9.15 (0.61– 168.53)	4.20 (1.57–5.66)	<b>0.019</b>	0.94 (0.20–35.05)	<b>0.00034</b>	<b>0.011</b>
CRP (mg/L)	52.85 (4.10–199.70)	4.50 (2.30–25.0)	<b>0.026</b>	2.7 (0.10–57.0)	<b>0.000003</b>	0.283
WBC ( $\times 10^9/L$ )	15.40 (2.90–49.0)	11.55 (6.10–28.70)	0.097	10.0 (5.0–24.0)	<b>0.007</b>	0.975
I:T neutrophil ratio	0.46 (0.30–0.71)	0.40 (0.33–0.47)	0.423	0.12 (0.04–0.30)	<b>0.005</b>	0.059

Median (min.–max.)

1 Nosocomial infections remain a serious problem at Neonatal Intensive Care Units.  
2 They develop due to colonization with hospital bacteria occurring during hospital stay of the  
3 patient [1]. The incidence rate in neonates is 1.4% globally [2] and 17-25% in intensive care  
4 units. Mortality is estimated at 17-72% depending on the gestational age of the neonate and  
5 etiology of the infection [3].  
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11 Increased procalcitonin (PCT) concentrations accompany infections, in particular  
12 those caused by bacteria [4, 5]. The present work was undertaken to determine whether PCT  
13 concentrations in neonates with nosocomial infections vary with pathogen type (Gram-  
14 negative bacilli vs coagulase-negative staphylococci - CoNS).  
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21 The study was conducted at the Department of Obstetrics and Perinatology  
22 Pomeranian Medical University. The study protocol was approved by the local bioethic  
23 committee.  
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29 Nosocomial infection was diagnosed by an experienced neonatologist on the basis of  
30 typical symptoms and laboratory findings. PCT concentrations in venous blood were  
31 determined in 52 neonates with nosocomial infection (group A; gestational age  $29.7 \pm 3.7$   
32 weeks; body mass  $1264 \pm 574$  g) and in 88 neonates without infection past the third day of  
33 life (control group B; gestational age  $30.0 \pm 5.1$  wks; body mass  $1502 \pm 950$  g). Venous blood  
34 in group A for cultures and laboratory tests was obtained at the onset of clinical symptoms of  
35 infection (mean age of neonate  $17 \pm 12$  days). Other parameters routinely used for the  
36 diagnosis of infection (CRP, WBC, I:T neutrophil ratio) were studied as well.  
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48 Groups were compared with the Mann-Whitney non-parametric U test. The Shapiro-  
49 Wilk W test revealed significant deviation from normal distribution in the case of PCT and  
50 CRP. Consequently, descriptive statistics for both parameters relied on median, minimal, and  
51 maximal values. The level of significance was taken as  $p = 0.05$ .  
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1 Positive blood cultures were noted in 34 (65.4%) neonates. Sepsis was caused by  
2 Gram-negative bacteria in 22, Gram-positive bacteria in 8, and *Candida* in 4 neonates. Gram-  
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4 positive bacteria were represented solely by hospital strains of staphylococci - coagulase-  
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6 negative, methicillin-resistant (MR) skin and hemolytic strains and *Staphylococcus aureus*  
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8 MR in one neonate. Gram-negative bacteria were represented by multi-resistant hospital  
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10 strains of *Klebsiella* sp. ESBL(+) (n=12), *Pseudomonas aeruginosa* MBL (n=1), *Enterobacter*  
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12 sp. AmpC, ESBL(+) (n=5), *Serratia* sp. (n=3), *Citrobacter freundii* (1).  
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17 PCT and CRP concentrations in group A and B differed significantly (PCT: 4.3 (0.25-  
18  
19 168.53) ng/mL vs 0.94 (0.20-35.05) ng/mL,  $p = 0.000001$ ; CRP: 20.30 (0.1-199.7) mg/L vs  
20  
21 2.7 (0.10-57.0) mg/L,  $p=0.000005$ , respectively). No significant differences between groups  
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23 were found for WBC and the I:T neutrophil ratio.  
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26 Infection by Gram-negative bacilli lead to highly significant increases in the  
27  
28 concentration of PCT and CRP, as well as in WBC and the I:T neutrophil ratio in comparison  
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30 with the control group. PCT and CRP were also significantly higher than in sepsis caused by  
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32 CoNS. In the case of CoNS sepsis, PCT concentrations were significantly higher ( $p = 0,011$ )  
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34 than in the control group and no significant difference for CRP was noted. Thus, procalcitonin  
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36 proved to be the only parameter which was significantly increased in sepsis caused by Gram-  
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38 positive hospital bacteria (chiefly CoNS) as compared with the control group (group A vs  
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40 group B) – table 1.  
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46 PCT concentrations in sepsis caused by *Candida* sp. differed from those in the control  
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48 group B ( $p = 0.029$ ) but no conclusions could be drawn due to the small number ( $N = 4$ ) of  
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50 *Candida* infections.  
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53 We observed elevated PCT concentrations in nosocomial infections regardless of the  
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55 result of blood culture, corroborating the findings of Franz et al. [4]. In the present, study,  
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57 PCT and CRP levels in sepsis caused by Gram-negative bacteria were significantly higher  
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1 than in the case of Gram-positive pathogens (chiefly CoNS). For Gram-negative and Gram-  
2 positive bacteria causing the sepsis, the only parameter which was elevated in comparison  
3 with the control group (B) was PCT. Therefore, CRP concentrations, as well as WBC and I:T  
4 neutrophil ratio cannot serve to disclose Gram-positive infections. These findings are in  
5 agreement with the observations of Kawczyński and Polakowska [5]. Chiesa et al. [6]  
6 reported on the low sensitivity of CRP and lower PCT levels in sepsis caused by CoNS as  
7 compared with Gram-negative bacteria. Pourcyrous et al. [7] did not find elevated CRP  
8 concentrations in neonates with positive blood cultures for *Staphylococcus epidermidis*,  
9 confirming other reports on the relatively low pathogenicity of this species [8].  
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22 The usefulness of PCT for the early diagnosis of sepsis caused by CoNS gains  
23 importance in view of the significant and rising contribution of these pathogens to the  
24 etiology of nosocomial infections in the neonate. Treatment at intensive care units often  
25 requires canulation of blood vessels and other invasive procedures which facilitate infection  
26 by *Staphylococcus epidermidis* known to adhere to silicon and form a protective coat  
27 composed of mucopolysaccharides which shields this pathogen from the immune system of  
28 the organism and blocks the entry of drugs (antibiotics). Until recently, positive blood  
29 cultures for CoNS were regarded as contamination during collection of the sample.  
30 Contamination is more likely in term neonates and older infants. However, in neonates with  
31 very low birth weight, the detection of this pathogen in culture usually reflects true  
32 bacteremia. According to Freeman et al. [9], bacteremia caused by CoNS has a late onset  
33 (mean age at detection was 20 days). Even though this pathogen is not responsible for  
34 increased mortality, CoNS infection prolongs treatment with antibiotics and hospital stay by  
35 approximately 12 days and 2.5 weeks, respectively. It is also worth noting that CoNS are the  
36 cause of the greatest number of late sepsis in neonates [3, 10].  
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Only PCT concentrations were higher in the case of infection with Gram-positive (chiefly CoNS), as well as Gram-negative bacteria. Concentrations of PCT venous blood represent a useful parameter for the diagnosis of nosocomial infections of the neonate with Gram-negative or Gram-positive bacteria (chiefly CoNS).

#### References:

1. Brady MT (2005) Health care – associated infections in the neonatal intensive care unit. *AJIC* 33:268-275.
2. Polin RA, Saiman L (2003) Nosocomial infections in the neonatal intensive care unit. *NeoReviews* 4:81–89.
3. Stoll BJ, Hansen N, Fanaroff AA, et al. (2002) Late-onset sepsis in very-low-birth-weight neonates: the experience of the National Institute of Child Health and Human Development Neonatal Research Network. *Pediatrics* 110:285–291.
4. Franz AR, Kron M, Pohlandt F, Steinbach G (1999) Comparison of procalcitonin with interleukin-8, C-reactive protein and differential white blood cell count for the early diagnosis of bacterial infections in newborn infants. *Pediatr Infect Dis J* 18:666–671.
5. Kawczyński P, Polakowska E (2004) Plasma levels of C-reactive protein, procalcitonin, interleukin-6 and interleukin-10 in preterm neonates evaluated for nosocomial sepsis. *Med Sci Monit* 10, Suppl. 2:58–61.
6. Chiesa C, Pacifico L, Rossi N, et al. (2000) Procalcitonin as a marker of nosocomial infections in the neonatal intensive care unit. *Int Care Med* 26:175–177.
7. Pourcyrous M, Bada HS, Korones SB, et al. (1993) Significance of serial C-reactive protein responses in neonatal infection and other disorders. *Pediatrics* 92:431–435.

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8. Benjamin DK, DeLong E, Cotten CM, et al. (2004) Mortality following blood culture in premature infants: increased with Gram-negative bacteremia and candidemia, but not Gram-positive bacteremia. *J Perinatol* 24:175–180.
9. Freeman J, Epstein MF (1990) Extra hospital stay and antibiotic usage with nosocomial coagulase-negative staphylococcal bacteriemia in two neonatal intensive care unit populations. *Am J Dis Child* 144:324-329.
10. Fendler WM, Piotrowski AJ (2008) Procalcitonin in the early diagnosis of nosocomial sepsis in preterm neonates. *J Paediatr Child Health* 44:114-118.



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