

Performance of Procalcitonin and Reactive Protein-C in the Diagnosis of Early Neonatal Infection At the C.H.U of Brazzaville

^{1,2}Jeanne Gambomi Kibah, ^{1,2}Arnaud Franck K Moukobolo, ^{1,2}Koumou Fylla Onanga, ^{1,2}Rod Ibara-Okadandé,
^{1,3}Nanikaly Moyen, ^{1,4}Etienne Mokondjimobé, ^{1,5}Gaston Bowassa Ekouya.

¹Faculty of Health Sciences, Marien Ngouabi University, Brazzaville, Congo.

²Biochemistry Department, CHU, Brazzaville, Congo

³Service de Bactériologie-Immunologie-Virologie CHU, Brazzaville Congo

⁴Lomo University of research, Kinshasa, DRC

⁵Neonatology Department, Centre Hospitalier Universitaire, Brazzaville, Congo

DOI : <https://doi.org/10.51583/IJLTEMAS.2025.140500107>

Received: 29 May 2025; Accepted: 02 June 2025; Published: 26 June 2025

Summary

The aim of this study was to evaluate the performance of procalcitonin and C-reactive protein in the diagnosis of early neonatal infection at Brazzaville University Hospital. This is a cross-sectional analytical study of 43 patients followed up in the Neonatology Department of the Brazzaville University Hospital Centre between July and November 2021. Procalcitonin, C-reactive protein and blood cultures were positive in 90.7%, 37.2% and 60% of cases respectively. The p-value was significant for procalcitonin ($p = 0.001$). The performance criteria for the biomarkers studied evolved in the opposite direction. However, the sensitivities of procalcitonin and C-reactive protein were 100% and 42.3% respectively, and the specificities of these biomarkers were 70.6% and 23.5% respectively. Procalcitonin cannot be used as the sole marker of neonatal infection ; it must always be combined with C-reactive protein.

Key words. neonatal infection; procalcitonin; C-reactive protein; Congo.

I. Introduction

An infected newborn requires appropriate and rapid management to limit the various complications and possible long-term sequelae [Adouani et al 2021]. Neonatal infection contributes substantially to neonatal morbidity and mortality and is a major public health challenge worldwide. According to the World Health Organisation (WHO), every year more than 4 million newborns die within 28 days of birth. Infections are considered the main cause of neonatal death (35%), followed by deaths resulting from premature delivery (28%), complications related to childbirth (24%) and asphyxia (23%). The developing world pays the highest price, particularly in sub-Saharan Africa and South-East Asia [Zelalem et al 2019; Debelew et al 2014]. Accurate and rapid diagnosis is essential if justified, rapid, effective and safe antibiotic therapy is to be instituted [Gregoriano et al 2020; Memar et al 2019]. Blood culture is the reference test for identifying sepsis, but it takes 24 hours to 7 days to obtain the results. Antibiotic therapy must be started early in neonates suspected of infection, to avoid multiple organ failure. Unjustified antibiotic therapy is a source of discomfort and puts pressure on the neonate's bacterial balance [Garnot et al 2006]. Thus the introduction of biochemical biomarkers, procalcitonin and C-reactive protein, may help in the early diagnosis of neonatal sepsis. In this context, the aim of this study is to evaluate the performance of procalcitonin and C-reactive protein in the diagnosis of early neonatal infection.

II. Methodology

This was an analytical cross-sectional study from July to November 2021. Newborns suspected of early bacterial infection were included. All newborns under treatment and/or less than 24 hours of age were excluded. Selection was exhaustive and consecutive. A total of 43 neonates meeting the above criteria were selected for the study. A triple epidemiological, clinical and biological investigation (age, sex, weight, clinical signs of infection, C-reactive protein, procalcitonin, blood culture) was carried out.

Blood cultures were taken before antibiotics were administered. The blood culture results were used to stratify the neonates into 2 groups with a positive blood culture (sepsis) and neonates with a negative blood culture (no sepsis).

The blood sample collected in the dry tube was centrifuged at 3,000 rpm for 5 minutes to obtain serum. The sera were aliquoted and stored at -80°C. The principle of quantitative determination of procalcitonin and C-reactive protein is based on fluorescence immunoassay technology (Finecare). The Fine care TM rapid quantitative test uses a sandwich immunodetection method based on an antigen and one or more antibodies.

Statistical analysis was performed using SPSS version 25.0 software. The Student's t test was used for associations between qualitative and quantitative variables. The Fischer Chi-square test was used for two qualitative variables. To assess the biomarkers,

we calculated performance indices (specificity, sensitivity, positive predictive value and negative predictive value). The significance threshold was set at $p < 0.05$.

III. Results

Among the 43 neonates included, blood cultures were positive in 60% of cases, with *E. coli* at the top of the list (Table 1). The majority were male (58%), with a sex ratio of 0.72. The mean age and weight of the neonates were 2.9 ± 1.3 and 2500 ± 700 grams respectively. Procalcitonin and C-reactive protein were positive in 90.7% and 37.2% respectively (table 2). The p value was significant for procalcitonin ($p = 0.001$) table 3. This study showed that the sensitivities of The principle of quantitative determination of procalcitonin and C-reactive protein is based on the specificity of these two biomarkers: 100% and 42.3% respectively, and 70.6% and 23.5% respectively, table 4.

Table 1. Distribution of patients according to blood culture results

Germes isolated	number (n)	Pourcentage (%)
Escherichia coli	7	16
Pseudomonas aeruginosa	3	7
Klebsiella pneumoniae	4	9
Pantoa SPP	2	5
Staphylococcus aureus	4	9
Staphylococcus epidermidis	3	7
Citobacter frenandia	3	7
Total	26	60%

Table 2. Biomarkers of neonatal infection (n = 43)

	Number	Pourcentage
CRP		
Négatif	27	62,8%
Positif	16	37,2%
PCT		
Négatif	4	9,3%
Positif	39	90,7%

Table 3. Mean and standard deviation of mean CRP and PCT in the two groups

	Infected (n = 26)	No d'infection (n = 17)	p
CRP	10,27± 10,28	13,24± 19,25	0,514
PCT	40,65± 25,45	6,94± 12,96	0,001

CRP : reactive protein C ; PCT ; procalcitonin

Table 4. Se, Sp, PPV, NPV of CRP and PCT in the two groups.

	Infection		No infection		p	Se	Sp	VPN	VPP
	n=26	%	n=17	%					
CRP					0,39	42,3	70,6	55,6	68,8
Négatif	15	57,7	12	70,6					
Positif	11	42,3	5	29,4					
PCT					0,009	100	23,5	0,00	66,7
Négatif	0	0,0	4	23,5					
Positif	26	100	13	76,5					

Se : sensitivity; Sp: specificity; NPV: negative predictive value; PPV: positive predictive value

IV. Discussion

Sepsis remains the most common reason for hospitalisation in our study (60%). Several studies report high rates of early neonatal infection [Kedy et al 2015; Chiabi et al 202011; Woldu et al 2014; Ghandhi et al 2013]. This most often reflects vertical transmission from mother to child before or during delivery [Walker et al 2015]. Male newborns were the most infected 58%. Our results are comparable to those found by Kemeze C et al in Cameroon who found 62% [Kemeze et al 2016]. Several studies report that males are more exposed to neonatal infection. However, Mulongo et al in the Democratic Republic of Congo found a predominance of females (52.9%) [Mulongo et al 2015]. Twenty-four (55%) neonates were born with low birth weight (< 2500 grams). These results are superposable with those of Manta et al in India and Nyenga et al in the Democratic Republic of Congo who found respectively (52.5%) (60%) [Jajoo et al 2015 ; Nyenga et al 2021]. Low birth weight can be linked to either intrauterine growth retardation or prematurity. In fact, on the one hand, newborns with intra-uterine growth retardation and those born prematurely present a greater risk of developing a bacterial infection due to a deficit in their immune defences. On the other hand, weight failure and prematurity may be the consequence of infectious aggression against the foetus [Romero et al 2007]. In contrast, Minko et al obtained 51% normal weight [Minko et al 2018]. We found that procalcitonin was statistically significant in comparison between the two groups. Adouni et al have shown that the procalcitonin assay has very good diagnostic value in distinguishing infected from uninfected neonates in early neonatal infections [Adouani et al 2021]. The sensitivity of C-reactive protein and procalcitonin was 42%, 3% and 100% respectively. The specificity for C-reactive protein was 70.6% and that for procalcitonin was 23.5%. Parc et al reported that procalcitonin had a sensitivity of 88.79% and a specificity of 58.17%, while C- reactive protein had a sensitivity of 100% and a specificity of 52.66% [Hathrill et al 2009]. Other similar studies showed that procalcitonin had a sensitivity of 66% to 92% and a specificity of 50% to 97; [Sakha et al 2008 ; Boo et al 2008 ; Monneret et al 2007]. In our study, the sensitivity of procalcitonin was higher than that of C-reactive protein, whereas the specificity of procalcitonin was lower than that of C-reactive protein. This means that procalcitonin as a separate diagnostic tool for neonatal sepsis may lead to more cases of false positives. The main problem with procalcitonin is the physiological increase in the first 24 hours of life. C-reactive protein can be considered a ‘specific’ but ‘late’ marker of early neonatal infection.

V. Conclusion

The complexity and conditions of emergency medicine alone justify the use of biological tools such as biomarkers, particularly in the field of infectious pathology. PCT and CRP are the biological markers most frequently measured in cases of suspected neonatal infection, and their blood levels help to diagnose infection and decide on antibiotic therapy. Contrary to other studies, which have chosen PCT as the most effective marker, our study shows that neither PCT nor CRP are ideal biomarkers. PCT has higher sensitivities than CRP (100% versus 42.3%), while CRP has higher specificities than PCT (70.6% versus 23.5%). In the light of these results, it seems difficult to exclude one of these markers, and their combination makes it possible to optimise management, provided that we know their respective characteristics in order to interpret them..

Author contributions: Conception, design of experiments and writing of the article: Jeanne Gambomi Kibah1and Arnaud Franck K Moukobolo

Conduct of experiments, data analysis: Jeanne Gambomi Kibah

Funding: None

Conflict of interest

We declare no conflict of interest related to this article.

References

1. Adouani F. Djabi neonatal infection: which biomarker for early diagnosis? *Journal Algérien de Biochimie et de Génétique Médicales* 2021 ; 1 ; 1-14
2. Zelalem Agnche, Hedja Yenus Yeshita & Kedir Abdela Gonete Septicémie néonatale et ses facteurs associés chez les nouveau-nés admis dans les unités de soins intensifs néonataux dans les hôpitaux primaires de la zone centrale de Gondar, nord-ouest de l'Éthiopie, *Infection et résistance aux médicaments* 2019 ; 13 :3957-67
3. Debelew GT, Afework MF, Yalew AW Déterminants et causes de la mortalité néonatale dans la zone de Jimma, sud-ouest de l'Éthiopie : une analyse à plusieurs niveaux de l'étude de suivi prospective. *PLoS UN* 2014 9(9) :
4. Gregoriano C, Heilmann E, Molitor A, Schuetz P. Role of procalcitonin use in the management of sepsis. *J Thorac Dis.* 2020;12(S1):S5–15.
5. Memar MY, Alizadeh N, Varshochi M, Kafil HS. Immunologic biomarkers for diagnostic of early-onset neonatal sepsis. *J Matern Neonatal Med* 2019;32(1):143–53.
6. Garnotel R, Jaisson S. Utilisation et apports de la protéine C-reactive et de la procalcitonine en néonatalogie. *Springer* 2006 ; 18 : 34.
7. Danielle C, Kedy K, Emmanuel Essomba, Guy Pascal Ngaba, Sintat Sintat , Paul Koki Ndombo3 , Yves Coppieters Morbidité et facteurs de risque de mortalité néonatale dans un hôpital de référence de Douala *Pan African Medical Journal.* 2015; 20:258
8. Andreas Chiabi, M.D., Marlène Djoupomb, M.D., Evelyn Mah, M.D., Séraphin Nguefack, M.D., Lawrence Mbuagbaw, M.D., Joseline Zafack, M.D., Madeleine Ghoyap, BSC, Thérèse Nkoa, M.D., et Pierre Fernand Tchokoteu, M.D. Le spectre clinique et bactériologique de la septicémie néonatale dans un hôpital tertiaire de Yaoundé, Cameroun *Iran J Pediatr.* 2011 21(4): 441–8
9. Woldu MA, Guta MB, Lenjisa JL, Tegegne GT, Tesafye G (2014) Assessment of the Incidence of Neonatal Sepsis, its Risk Factors, Antimicrobials Use and Clinical Outcomes in Bishoftu General Hospital, Neonatal Intensive Care Unit, Debrezeit-Ethiopia. *Pediat Therapeut* 4: 214.
10. Gandhi S, Ranjan KP, Ranjan N, Sapre N, Masani M. Incidence of neonatal sepsis in tertiary care hospital: an overview. *Int J Med Sci Public Health* 2013; 2:548-52.
11. Walker O et al., Neonatal sepsis, *Paediatrics and Child Health, Journal de néonatalogie clinique* 2015 ; (2):91-5.
12. Kemeze S, Moudze B, Chiabi A, Eposse C, Kaya A, Mbangue M, Guifo O, Kago I. Profil clinique et bactériologique des infections néonatales bactériennes à l'Hôpital Laquintinie de Douala, Cameroun. *Pan Afr Med J.* 2016 ; 23 :97.
13. Mulongo Mbarambara, C. Wakeka kabyuma, M. Mudimba Lamata, JP. Bahati Maheshe, C. Kyambikwa Bisangamo Fréquence et facteurs de risque des infections néonatales à l'Hôpital Général de Référence d'Uvira les technologies de laboratoire 2015, vol 9, n°37
14. Jajoo, Mamta ; Kapoor, Kapil ; Garg, L. K. ; Mandchou, Vikas1 ; Mittal, S. K. Étudier l'incidence et les facteurs de risque de septicémie néonatale précoce dans une unité de soins intensifs néonataux de l'Inde *Journal de néonatalogie clinique* 2015 ; 4(2): 91-5.
15. Nyenga AM, Mukuku O, Mutombo AK, Luboya ON, Wembonyama SO. Epidémiologie de la septicémie néonatale à Lubumbashi, République Démocratique du Congo. *Journal of Medicine, Public Health and Policy Research.* 2021;1(1):6-13
16. Roberto Romero, Jimmy Espinoza, Lui's F, Goncalves, Juan Pedro Kusanovic, Lara Friel, Sonia Hassan. The Role of Inflammation and Infection in Preterm Birth seminars in reproductive medicine 2007 ;25, number 1
17. Minko JI, Minto'o RS, Kuissi KE, Lembet MA, Wassef WS, Ngonde L, et al. Neonatal Infections at the University Hospital Center of Libreville: Epidemiological, Clinical and Biological Characteristics. *Neonatal Pediatr Med.* 2018 ; 04 (02) : 154-59
18. Hatherill M, Tibby SM, Sykes K, Turner C, Murdoch IA. Diagnostic markers of infection: Comparison of procalcitonin with C reactive protein and leucocyte count. *Arch Dis Child* 2009;81:417-21
19. Sakha K, Hussein MB, Seyyedsadri N. The role of the procalcitonin in diagnosis of neonatal sepsis and correlation between procalcitonin and C-reactive protein in these patients. *Pak J BiolSci* 2008;11:1785-90.
20. Boo NY, Nor Azlina AA, Rohana J. Usefulness of a semi-quantitative procalcitonin test kit for early diagnosis of neonatal sepsis. *Singapore Med J* 2008;49:204-8.
21. Monneret G, Labaune JM, Isaac C, Bienvenu F, Putet G et al Procalcitonin and C-reactive protein levels in neonatal infections. *ActaPaediatr* 2007; 86:209-12