Eur J Pediatr (2005) 164: 651–652
DOI 10.1007/s00431-005-1700-5

SHORT REPORT

**David Tuerlinckx · Thierry Vander Borght
Youri Glupczynski · Laurence Galanti
Véronique Roelants · Bruno Krug
Georges de Bilderling · Eddy Bodart**

Is procalcitonin a good marker of renal lesion in febrile urinary tract infection?

Received: 6 December 2004 / Accepted: 7 April 2005 / Published online: 16 July 2005

Introduction

Four recent prospective studies have suggested that procalcitonin (PCT), a polypeptide produced by the macrophage-monocyte system during severe bacterial infection, might be more specific than leukocyte count or C-reactive protein (CRP) in predicting acute renal involvement during an episode of febrile urinary tract infection (UTI) [1, 2, 3, 5]. The aim of our prospective study was to confirm such findings.

Method

Blood samples were collected at admission for the determination of white blood cells (WBCs) and neutrophil counts, CRP value (normal value < 5 mg/l) and PCT level (Lumitest PCT; Brahms Diagnostica; normal value < 0.5 ng/ml) in all 1-month to 15-year-old children admitted to our hospital between January 1999 and December 2003 with a culture-proven first episode of febrile UTI. Acute renal involvement was assessed by ^{99m}Tc-dimercaptosuccinic acid (DMSA) scintigraphy performed within 72 h of admission.

D. Tuerlinckx (✉) · G. de Bilderling · E. Bodart
Department of Paediatrics, Cliniques de Mont-Godinne,
Université Catholique de Louvain, 5530 Yvoir, Belgium
E-mail: david.tuerlinckx@pedi.ucl.ac.be
Tel.: +32-81-423461
Fax: +32-81-426461

T. Vander Borght · V. Roelants · B. Krug
Department of Nuclear Medicine, Cliniques de Mont-Godinne,
Université Catholique de Louvain, Yvoir, Belgium

Y. Glupczynski
Department of Microbiology, Cliniques de Mont-Godinne,
Université Catholique de Louvain, Yvoir, Belgium

L. Galanti
Department of Biochemistry, Cliniques de Mont-Godinne,
Université Catholique de Louvain, Yvoir, Belgium

A subset of patients with abnormal initial DMSA scintigram results were given a repeated DMSA scan 6 months later. Evolution of lesion(s) was classified as reversible (totally or partially) or scars. Patients' ages and laboratory data between children with or without renal involvement were compared using the Wilcoxon rank sum test (SPSS 10.0), with $P < 0.05$ being considered as statistically significant. The diagnostic accuracy of CRP and PCT and the best cut-off points were determined by receiver operating characteristic (ROC) analysis (MedCalc 7.4, Belgium). The sensitivity and specificity of CRP and PCT for detection of renal lesions, defined as abnormal DMSA scan results, were calculated for the optimal cut-off points.

Results and discussion

A total of 63 children (49 girls), from 2 months to 14 years of age (mean age 44 months), was included. Initial DMSA scan revealed renal lesions in 50 (79%) children. Except for patient age, there were no significant differences in WBC and neutrophil counts, or CRP or PCT levels between children with or without abnormal DMSA scan results (Table 1). The median values of PCT and CRP between the two groups were, respectively, 1.5 ng/ml and 99 mg/l in the group with abnormal DMSA scans, compared with 1.1 ng/ml ($P = 0.42$) and 75 mg/l ($p = 0.25$) in the group with normal DMSA scan results. Follow-up scans, performed on 38 patients, showed reversible lesion(s) in 34 cases and scars in four cases.

Similar results were found when children with reversible lesion(s) at follow-up scan were compared with children with normal DMSA scan at admission (Table 1). The median PCT level was not statistically different between children with totally and partially reversible lesion(s) ($P = 0.3$). The area under the ROC curve, determined to differentiate children with or

Table 1 Comparison of clinical and laboratory data between patients with and without renal lesion(s) based on acute DMSA scan results and on follow-up scan results. Results are expressed as median (range). *P* value = between patients with initial abnormal DMSA scan and normal DMSA scan and between patients with reversible lesion(s) at follow-up DMSA scan and normal DMSA scan

	Normal DMSA scan ($n = 13$)	Initial abnormal DMSA scan ($n = 50$)	*P*	Reversible lesion(s) ($n = 34$)	*P*
Age (months)	21 (1–76.8)	55.5 (2–168)	0.019	58 (6–168)	0.01
CRP (mg/l)	75 (26–212)	99 (24–320)	0.25	107 (24–320)	0.27
PCT (ng/ml)	1.1 (0.1–7.3)	1.5 (0.12–30.5)	0.42	1 (0.12–29)	0.81
WBCs ($10^3/mm^3$)	16.3 (7.6–28.6)	15.3 (7–27.5)	0.88	15.15 (7.9–27.5)	0.77
Neutrophils ($10^3/mm^3$)	10.75 (4.65–19.37)	10.9 (3.39–20.6)	0.81	10.72 (3.39–20.6)	0.85

without renal lesions, as assessed by initial DMSA scan result, was 0.57 for PCT and 0.60 for CRP. With a cut-off point of 1.7 ng/ml for PCT and 34 mg/l for CRP, sensitivity and specificity were 46% and 77% for PCT and 94% and 38.5% for CRP, respectively. With a cut-off point of 0.5 ng/ml for PCT, sensitivity and specificity were 68% and 23%, respectively. If reversible DMSA lesion(s) were considered as being UTI, sensitivity of PCT (cut-off point of 0.5 ng/ml) was 64%.

Four previous studies have shown that PCT ≥0.5 ng/ml had a high sensitivity (70.3% to 94%) and specificity (70.2% to 88.7%), suggesting that PCT determination during an acute febrile UTI might help in differentiating upper UTI from lower UTI [1, 2, 3, 5]. Diagnostic criteria used to define renal involvement during UTI were based on acute DMSA scan appearance [2, 3] or on the evolution of the lesion(s) during follow-up DMSA scan compared with the first scan [1, 5]. The sensitivity of PCT to predict renal involvement reported in our study was not related to the diagnostic criteria used to define renal involvement, and we found a much lower specificity (23%) than that previously reported.

The discrepancy between low PCT level (< 0.5 ng/ml), in spite of abnormal DMSA scan and high CRP level, could not be explained by the severity of the disease, as we found no difference in the PCT level between the group with totally reversible lesion(s) and those with partially reversible lesion(s). On the contrary, Benador et al. [1] and Pecile et al. [5] found a positive relationship between PCT level at admission and the severity of the disease as assessed by initial DMSA or by the evolution of the lesions at follow-up scan. Prat et al. have also demonstrated the correlation between a low PCT value at admission and a low risk of long-term renal scarring after UTI [4].

As in other studies we could confirm the very high sensitivity of CRP, suggesting that children with normal CRP values could probably be considered has having no renal lesions. Its low specificity was, however, not found to be helpful for predicting the differential diagnosis between febrile UTI with or without renal lesions [1, 2, 3, 5, 6]. In summary, the sensitivity and specificity of PC to predict renal lesions during acute febrile UTI may not be as high as described in previous studies, whatever DMSA scan diagnostic criteria were used to define acute pyelonephritis. Further well-designed prospective studies are needed to delineate better the value of PCT determination in the management of febrile UTI in childhood and, particularly, its relation to the severity of the disease.

References

1. Benador N, Siegrist CA, Gendrel D, Greder C, Benador D, Assicot M, Bohuon C, Girardin E (1998) Procalcitonin is a marker of severity of renal lesions in pyelonephritis. Pediatrics 102:1422–1425
2. Gervaix A, Galetto-Lacour A, Gueron T, Vadas L, Zamora S, Suter S, Girardin E (2001) Usefulness of procalcitonin and C-reactive protein rapid tests for the management of children with urinary tract infection. Pediatr Infect Dis J 20:507–511
3. Pecile P, Miorin E, Romanello C, Falleti E, Valent F, Giacomuzzi F, Tenore A (2004) Procalcitonin: a marker of severity of acute pyelonephritis among children. Pediatrics 114:e249–e254
4. Prat C, Dominguez J, Rodrigo C, Gimenez M, Azuara M, Jimenez O, Gali N, Ausina V. (2003) Elevated serum procalcitonin values correlate with renal scarring in children with urinary tract infection. Pediatr Infect Dis J 22:438–442
5. Smolkin V, Koren A, Raz R, Colodner R, Sakran W, Halevy R (2002) Procalcitonin as a marker of acute pyelonephritis in infants and children. Pediatr Nephrol 17:409–412
6. Stokland E, Hellström M, Jakobsson B, Jodal U, Lundgren P, Sixt R (1996) Early ^{99m}Tc dimercaptosuccinic acid (DMSA) scintigraphy in symptomatic first-time urinary tract infection. Acta Paediatr 85:430–436