Procalcitonin fails to rule out bloodstream infection in patients with SIRS: a case-control study

Medical University of Graz

M. Hoenigl[1], R.B. Raggam[2], J. Wagner[1], F. Prueller[2], J. Prattes[1], K. Seeber[1], E. Leitner[3], I. Zollner-Schwetz[1], A.J. Grisold[3], R. Krause[1].

1 Section of Infectious Diseases and Tropical medicine, Medical University of Graz, Graz, Austria.

2 Clinical Institute of Medical and Chemical Laboratory Diagnostics, Medical university of Graz, Graz, Austria.

3 Institute of Hygiene Microbiology and Environmental Medicine, Medical university of Graz, Graz, Austria.

martin.hoenigl@medunigraz.at

Background: Procalcitonin (PCT) has previously been proposed as useful marker to rule out BSI. The objective of this study was to evaluate the sensitivity of different PCT cut-offs for prediction of BSI in patients with community (CA)- and hospital-acquired (HA)-BSI.

Methods: Between January 2011 and December 2012 a total of 898 patients fulfilling SIRS criteria were enrolled in this prospective case-control study at the Medical University of Graz, Austria. Of those, 666 patients had positive blood cultures (282 CA-BSI, 384 HA-BSI). 232 patients had negative blood culture results (all had not received systemic antiinfective therapy five days prior to collection of blood cultures) and served as controls. Receiver operating characteristics (ROC) curve analysis was performed for PCT and IL-6. Area under the curve (AUC) values were displayed including 95% Confidence Interval (CI).

Results: PCT was significantly ($p<0.001$) higher in patients with bacteremia/fungemia than in those without and proved to be superior to IL-6 and CRP. ROC curve analysis revealed an AUC value of 0.675 for PCT (95% CI 0.636-0.714) for differentiating patients with BSI from those without. AUC for IL-6 was 0.558 (95% CI 0.515-0.600). However, even at the lowest cut-off evaluated (i.e. 0.1 ng/mL) PCT failed to predict BSI in 7% (n=46; 6% CA-BSI, 8% HA-BSI) of patients. Sixteen of these 46 cases had CA-BSI. Detected pathogens were CoNS (n=8, each more than one culture bottle positive), Escherichia coli (n=3), Staphylococcus aureus (n=2), Enterobacter cloacae, Propionibacterium acnes, and Peptostreptococcus (n=1 each). Two of these 16 patients had to be admitted to the ICU, one patient died in septic shock within 24 hrs, all others survived at day 90. The remaining 30/46 patients had HA-BSI due to Staphylococcus aureus (n=6), Enterococcus spp. (n=5), Pseudomonas spp. (n=4), CoNS (n=4), Escherichia coli (n=2), Streptococcus spp. (n=2), Klebsiella pneumoniae (n=2), Candida spp. (n=2), Proteus vulgaris, Bacteroides fragilis, and Agrobacterium tumefaciens (n=1 each). In the control group (SIRS and negative blood culture result) 79% (n=185) had PCT levels >0.1.

	BSI (n=666)	Negative blood cultures (n=232)	p-value (if significant)
Age (years)	66 (IQR 54-76)	68 (IQR 51-77)	
Sex (f/m)	284/382	95/137	
PCT (ng/mL)	1.06 (IQR 0.31-7.6)	0.29 (IQR 0.12-1.30)	p<0.001
IL-6 (pg/mL)	223 (IQR 82-840)	174 (76-401)	p=0.01
CRP (mg/L)	108 (IQR 50-201)	108 (IQR 40-210)	
Serum creatinine (mg/dL)	1.25 (IQR 0.89-2.30)	1.16 (IQR 0.91-1.74)	
Days hospitalized after collection of positive blood culture (days)	13 (IQR 8-21)	8 (IQR 5-11)	p<0.001

Conclusion: Considering (a) the relatively high costs of PCT measurements, (b) the potential costs of prolonged hospitalizations, morbidity and mortality due to delayed diagnosis in BSI patients with low PCT, and (c) the fact that PCT may reduce negative blood cultures by 20% only, a PCT guided approach for blood cultures may not seem feasible.