Is procalcitonin really the specific marker for serious bacterial infection in febrile children?

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Introduction

For the early detection of bacterial infections, especially serious bacterial infection (SBI) or invasive bacterial infection (IBI), many inflammatory markers are used.

- **Definition**
Invasive Bacterial Infection (IBI)
isolation of bacteria from **blood CSF urine**
Serious Bacterial Infection (SBI)

- **Procalcitonin (PCT)**
early inflammatory marker specific for **bacterial infection**

- ◆ PCT elevations other than bacterial infection :
Kawasaki disease, autoimmune disease, viral infection
(ex. HHV-6, adeno virus)

Specific aim

For the early detection of SBI or IBI,
we analyzed the utility of PCT in highly elevated cases.

Methods

Children admitted to our hospital and sampled PCT in 2016

We analyzed group A and B.

Results

group A (PCT ≥ 10 ng/ml)

No.	Sex	Age (mo)	diagnosis	PCT (ng/ml)	WBC (/μl)	CRP (mg/dl)	Blood Culture
1	M	1	UTI (ESBL+ <i>E. coli</i>)	48.5	14,500	11.7	
2	F	7	UTI (ESBL+ <i>E. coli</i>)	44.6	4,350	13.7	
3	M	4	UTI (<i>Klebsiella pneumoniae</i>)	35.5	34,900	8.5	
4	M	1	Bacteremia (GBS)	27.5	15,400	2.3	+
5	M	16	Bacteremia (<i>S. pneumoniae</i>)	25.6	47,600	15.7	+
6	M	1	meningitis + UTI (<i>E. coli</i>)	25.2	12,800	17	+
7	F	6	UTI (ESBL+ <i>E. coli</i>)	24.3	12,700	9.4	
8	F	3	UTI (ESBL+ <i>E. coli</i>) + Bacteremia	22.2	13,300	7.6	+
9	M	16	Pneumonia	21.6	34,200	15.3	
10	M	4	UTI (ESBL+ <i>E. coli</i>)	20.5	24,000	10.9	
11	M	1	UTI (ESBL+ <i>E. coli</i>) + Bacteremia	16.1	14,400	10.1	+
12	F	24	Pneumonia	11.0	6,200	6.1	
Avg.		7		26.9	19,529	10.7	

group B (10 > PCT ≥ 5 ng/ml)

No.	Sex	Age (mo)	diagnosis	PCT (ng/ml)	WBC (/μl)	CRP (mg/dl)	Blood Culture
1	M	3	UTI (ESBL+ <i>E. coli</i>)	8.6	8,400	6.9	—
2	M	7	UTI (ESBL+ <i>E. coli</i>)	8.5	26,800	8.0	—
3	M	1	Pneumonia	8.0	4,700	1.2	—
4	F	4	UTI (ESBL+ <i>E. coli</i>)	7.9	14,500	6.5	—
5	F	14	UTI (ESBL+ <i>E. coli</i>)	7.9	26,500	10.2	—
6	M	4	UTI (ESBL+ <i>E. coli</i>)	7.9	12,000	4.0	—
7	F	13	Cellulitis	7.4	31,200	6.2	—
8	M	2	UTI (ESBL+ <i>E. coli</i>)	6.6	17,100	3.9	—
9	M	14	Pneumonia	6.6	14,300	3.8	—
10	F	10	Exanthema subitum	6.3	8,500	5.0	—
Avg.		7.2		7.6	16,400	5.6	

Summarized Results

group A

SBI 10/12 (83%) including 6 UTIs (ESBL+ *E. coli*)
IBI 5/12 (42%)

group B

SBI 6/10 (60%) including 6 UTIs (ESBL+ *E. coli*)
IBI 0/10 (0%)

Suggestions

1. PCT ≥ 5 ng/ml ⇒ high possibility of UTI (ESBL+ *E. coli*)
2. PCT ≥ 10 ng/ml ⇒ IBI

Discussion

- The number of UTI and pathogens in our hospital

- Influence of ESBL for PCT

comparison of UTI ESBL+ *E. coli* vs. *E. coli* in 2016

n	Sex (M:F)	Age (mo)	uropathogen	PCT (ng/ml)	WBC (/μl)	CRP (mg/dl)
30	21 : 9	8.4	ESBL+ <i>E. coli</i>	8.3	18,600	8.8
4	1 : 3	4.0	<i>E. coli</i>	1.5	22,800	7.3

(mean age, PCT, WBC, CRP)

- ⇒ PCT is higher in UTIs caused by **ESBL+ *E. coli*** than *E. coli*

- IBI cases without high PCT elevation

No.	Sex	Age (mo)	diagnosis	PCT (ng/ml)	WBC (/μl)	CRP (mg/dl)	Blood Culture
1	M	5	UTI (ESBL+ <i>E. coli</i>)	2.24	14,460	4.36	+
2	M	4	UTI (ESBL+ <i>E. coli</i>)	1.68	19,960	3.38	+
3	M	9	Septic arthritis (MSSA)	0.25	14,320	6.17	+
4	M	84	Purulent lymphadenitis (GAS)	0.21	3,000	0.84	+

- Duration of fever before the admission

Two UTIs : **only 3 hours**
Other IBIs : **24-72 hours**

- Difference of bacterial pathogens

PCT level: **Gram Negative > Gram Positive** bacteria

Charles, et al. *BMC Infect Dis* 2008; 8:38

Conclusion

- ✓ High PCT (≥ 5 ng/ml) might be UTIs caused by ESBL producing *E. coli*.
- ✓ PCT ≥ 10 ng/ml suggests high possibility of IBI.