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Procalcitonin (PCT)
in Sepsis

PCT algorithms for antibiotic guidance

When to START antibiotics?

PCT sepsis cut-off
<0.5 µg/L

- Yes → Bacterial infection unlikely ▸ ABx NOT recommended*
- No → Bacterial infection likely ▸ ABx recommended

When to STOP antibiotics?[1]

Daily measurement of PCT is advised

Decline in PCT from peak value
ΔPCT ≥80%

- Yes → Stop ABx
- No → **Current PCT value** **<0.5 µg/L**
  - Yes → Stop ABx
  - No → Continue/change ABx

* Antibiotic treatment should be started/continued on suspicion of infection, particularly in high-risk patients.

$$\Delta PCT = \frac{\text{Peak PCT} - \text{Current PCT}}{\text{Peak PCT}} \times 100\%$$

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PCT reference ranges for diagnosis of Systemic Bacterial Infection/Sepsis[2]

PCT <0.05 µg/L ▸ **Healthy individuals**

PCT <0.5 µg/L ▸ **Systemic infection (sepsis) not likely. Local bacterial infection is possible.**

Low risk for progression to severe systemic infection (severe sepsis).
Caution: PCT levels below 0.5 µg/L do not exclude an infection, because localized infections (without systemic signs) may be associated with such low levels. Also if the PCT measurement is done very early after a following bacterial challenge (usually <6 hours), these values may still be low. In this case, PCT should be re-assessed 6-24 hours later.

PCT ≥0.5 – <2 µg/L ▸ **Systemic infection (sepsis) possible, but various other conditions are known to induce PCT as well***

Moderate risk for progression to severe systemic infection (severe sepsis). The patient should be closely monitored both clinically and by re-assessing PCT within 6-24 hours.

PCT ≥2 – <10 µg/L ▸ **Systemic infection (sepsis) likely, unless other causes are known***

High risk for progression to severe systemic infection (severe sepsis)

PCT ≥10 µg/L ▸ **Important systemic inflammatory response, almost exclusively due to severe bacterial sepsis or septic shock***

High likelihood of severe sepsis or septic shock

* **PCT values may be elevated in certain conditions independent of bacterial infection. These include, but are not limited to:**
- Injuries including major trauma, burns and heat stroke
- Acute medical conditions such as biliary pancreatitis, chemical pneumonitis, viral hepatitis and/or decompensated severe cirrhosis (Child-Pugh Class 3), prolonged or severe cardiogenic shock, prolonged severe organ perfusion anomalies, and post-cardiac arrest
- Active medullary C-cell carcinoma, small cell lung carcinoma, and bronchial carcinoid
- Unusual infectious diseases including invasive fungal infections and acute plasmodium falciparum malaria
- Following interventions such as surgery with extra-corporeal circulation, treatment with drugs stimulating release of pro-inflammatory cytokines or resulting in anaphylaxis, peritoneal or hemodialysis
- Neonates during the first three days of life. PCT values should be interpreted using a specific nomogram during the first 72 hours following birth (Stocker et al. Neonatology 2010; 97: 165-174).

The PCT reference ranges are valuable guidelines for the clinician but they should always be interpreted in context of the patient's clinical condition. PCT serum concentrations are elevated in clinically relevant bacterial infections and continue to rise with the increasing severity of the disease. However, as an expression of individually different immune responses and different clinical situations, the same focus of infection may be associated with varying individual elevations in PCT concentrations. Antibiotic treatment should be started/continued on suspicion of infection, particularly in high-risk patients.

References 1 de Jong et al., Lancet Infect Dis 2016; 3099: 1-9. **2** Meisner M. Procalcitonin – Biochemistry and Clinical Diagnosis. Bremen 2010.

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