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Procalcitonin (PCT) and Sepsis

Frequently Asked Questions

Answers for life.

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Procalcitonin (PCT) and Sepsis



What are the consensus definitions for sepsis and related conditions?

The broad term sepsis encompasses several degrees of disease severity, defined as SIRS, sepsis, severe sepsis, and septic shock. Definitions for related conditions include those for multiorgan dysfunction and sepsis-induced hypotension.^{1,2}

Systemic inflammatory response syndrome (SIRS) is a systemic inflammatory response to a variety of clinical insults. The response is manifested by two or more of the following conditions: (1) temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ (2) heart rate >90 beats per minute; (3) respiratory rate >20 breaths per minute or PaCO_2 , <32 mm Hg; and (4) white blood cell count $>12,000/\mu\text{L}$, $<4,000/\mu\text{L}$, or $>10\%$ immature (band) forms.^{1,2}

Sepsis is a systemic inflammatory response (SIRS) in the presence of a confirmed or suspected infection. SIRS is manifested by two or more of the conditions detailed previously.

Severe sepsis is sepsis associated with organ dysfunction, hypoperfusion, or hypotension. Hypoperfusion abnormalities may include but are not limited to lactic acidosis, oliguria, or an acute alteration in mental status.^{1,2}

Septic shock is sepsis-induced hypotension despite adequate fluid resuscitation along with the presence of perfusion abnormalities that may include but are not limited to, lactic acidosis, oliguria, or an acute alteration in mental status. Patients who are receiving inotropic or vasopressor agents may not be hypotensive at the time that perfusion abnormalities are measured.^{1,2}

Sepsis-induced hypotension is a systolic blood pressure <90 mm Hg or a reduction of ≥ 40 mm Hg from baseline in the absence of other causes of hypotension.^{1,2}

Multiple organ dysfunction syndrome (MODS) is the presence of altered organ function in an acutely ill patient such that homeostasis cannot be maintained without intervention.^{1,2}

What is the incidence of severe sepsis in the ICU?

The worldwide incidence of severe sepsis in the ICU ranges from 6.3% to 27.1%, with associated mortality ranging from 17.9% to 52.2%.³

What is the mortality rate for sepsis and related conditions?

The 28-day mortality rate for SIRS is approximately 10%; for sepsis $\sim 20\%$; for severe sepsis $\sim 20\%$ to 40% ; and for septic shock $\sim 40\%$ to 60% .⁴

What are the costs associated with sepsis?

The US costs for severe sepsis alone were estimated to be \$16.7 billion per year with 751,000 cases. Growth in the number of cases was projected to be 1.5% per year.⁵

What is procalcitonin (PCT)?

PCT is a 116 amino acid prohormone of the hormone calcitonin. Calcitonin is exclusively produced by C-cells of the thyroid gland in response to hormonal stimuli, whereas PCT can be produced by several other cell types from a wide range of organs in response to inflammation or infection.⁶⁻⁸ The exact biological role of PCT remains largely unknown, however, recent experimental studies suggest that PCT may play a pathogenic role in sepsis.⁸

What affects PCT levels?

Bacterial endotoxins, and proinflammatory cytokines (IL-1, IL-2, IL-6, TNF α) are powerful stimuli for PCT production.⁷⁻¹¹

What is the reference range for PCT?

In healthy people, plasma PCT concentrations are typically below 0.05 ng/mL, but PCT concentrations can increase up to 1000 ng/mL in patients with sepsis, severe sepsis or septic shock.^{7,9} PCT concentrations exceeding 0.5 ng/mL are generally considered abnormal,^{7,10} and values in the range of 0.5 and 2 ng/mL suggests that the patient is at risk for sepsis and generally represent a gray zone in terms of the assessment of sepsis and related conditions.¹⁰

How do PCT levels change in sepsis?

PCT levels increase within ~ 3 to 6 hours of the stimulus.^{8,10} Higher PCT levels are associated with poorer prognosis and are found in patients with sepsis, severe sepsis, and septic shock. Viral infections do not typically result in elevated PCT levels.^{8,10}

In what types of patients should PCT levels be evaluated?

Patients who are at risk for or suspected of having sepsis are eligible for PCT evaluation.¹²

How should PCT values be interpreted?

PCT is a marker of the inflammatory response. Elevated values are highly suggestive of an infection, often bacterial, with a systemic response. When plasma PCT values are below 0.5 ng/mL, bacterial sepsis is unlikely. PCT levels above 2 ng/mL are associated with bacterial infection and an increased likelihood of sepsis and progression to severe sepsis, however, other causes should not be excluded. PCT levels between 0.5 and 2 ng/mL, represent a gray zone where sepsis cannot be excluded.^{13,14} PCT levels should be used in conjunction with other clinical information and not in isolation.^{13,14} Table 1 provides more information on the interpretation of PCT values.

When should PCT measurements be initiated and repeated?

PCT measurements should be initiated at the time of admission or at any time during the hospital stay, when sepsis is suspected.¹⁴

Measurement should be repeated within 6 to 24 hours in patients with concentrations that are only slightly elevated (<2 ng/mL) and/or if the patient presents with clinical signs and symptoms consistent with sepsis.¹⁴

Measurement should be repeated every 24 hours in patients who are at risk for developing sepsis and organ dysfunction, and as an aid to evaluate response to therapy in septic patients.¹⁴

What other conditions are associated with increased PCT levels?

Elevated PCT levels are observed in neonates (aged less than 48 hours) and during the first day(s) after a major trauma, major surgery, severe burns, and treatment with OKT3 antibodies and other drugs stimulating the release of proinflammatory cytokines. PCT levels are also increased in patients with prolonged or severe cardiogenic shock, prolonged severe organ perfusion abnormalities, small-cell lung cancer or medullary C-cell carcinoma of the thyroid. Thus PCT values should be interpreted in the context of the patient's clinical and laboratory information.^{8,13}

What is the half-life and stability of PCT?

Plasma PCT has a half life of 25 to 30 hours.⁷ PCT is stable in both plasma and serum samples. Samples stored at room temperature for 24 hours retain 80 percent of their initial concentration, whereas those stored at 4°C retain >90 percent of their initial concentration.¹⁴



Table 1. PCT levels and possible interpretation.¹²⁻¹⁴

PCT (ng/mL)	Possible interpretations
<0.05	<ul style="list-style-type: none">• Normal values• Local inflammation or infection is possible: systemic inflammatory response unlikely
<0.5	<ul style="list-style-type: none">• On first day of ICU admission this indicates a low risk for progression to severe sepsis and/or septic shock• Local inflammation or infection is possible: systemic inflammatory response unlikely
≥0.5 and <2.0	<ul style="list-style-type: none">• Systemic inflammatory response present due to infection, severe trauma, major surgery or cardiogenic shock• If the patient has a proven infection it could be sepsis
≥2.0 and <10	<ul style="list-style-type: none">• Likely to be sepsis (systemic inflammatory response associated with infection)• On first day of ICU admission this indicates a high risk for progression to severe sepsis and/or septic shock
≥10	<ul style="list-style-type: none">• Severe sepsis or septic shock• Organ dysfunction• High risk of death



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