

Procalcitonin in the paediatric intensive care unit

Key facts

- No marker of infection can rule in or rule out sepsis in all children
- Procalcitonin (PCT) is an early marker of sepsis; it is more sensitive and specific than C-reactive protein (CRP) ¹⁻³
- In normal healthy children the reference range for PCT is <0.05 ng/ml (or microgram per L)
- In local infection the PCT is typically >2 ng/ml, but may be in the range 0.5-2 ng/ml
- In systemic inflammatory response without bacteraemia PCT is typically 0.5-2 ng/ml ³
- **In bacteraemic sepsis PCT is almost always >2 ng/ml, usually >10 ng/ml, and often in the 100s** ^{2;3}
- Post cardiopulmonary bypass the PCT increases, peaking on day 2. In the absence of infection the PCT level post-CPB is typically <2.2 ng/ml ²
- In neonates in the first 48 hours of life PCT levels are higher than the normal range in older children. A PCT of <10ng/ml can be seen in normal healthy newborns at 24-48 hours, but in a sick neonate a PCT >10 ng/ml strongly suggests sepsis
- **For excluding bacterial lung co-infection in viral syndromes (viral pneumonia or bronchiolitis), where there is no bacteraemia, a cut-off of 0.8 ng/ml is suggested by the research so far.** ^{4;5} What does this mean?
 1. This *doesn't* mean that all children with viral bronchiolitis and a PCT above 0.8 should receive antibiotics (if the CXR does not show consolidation, if the IT ratio is <0.2, and the PCT is between 0.8 and 2, then the probability of bacterial pneumonia is still very low).
 2. In a ventilated (or CPAP) child in ICU with a lower respiratory viral infection where there *is significant alveolar consolidation* on x-ray and a PCT of >0.8, it is reasonable to start antibiotics (after a BAL if possible).
 3. Most importantly: in a child with clinical bronchiolitis, or a viral lower respiratory tract syndrome, *even in the presence of consolidation*, a PCT of <0.8 means bacterial infection is very unlikely to be present – especially if the IT ratio is low - and it is quite reasonable **not to treat with antibiotics**
- PCT decreases after infection is treated adequately
- At RCH it takes about 2 hours to get a PCT result

We should measure PCT when there is uncertainty about whether to start or withhold antibiotics for suspected systemic sepsis

PCT should be used as part of the algorithm to determine if there is systemic bacterial infection: http://www.wch.org.au/emplibrary/picu_intranet/Antibiotics_in_the_PICU.pdf

Are there signs of a bacterial infection?

- Fever or temperature instability *plus*
- an increasing IT ratio (>0.2) *or*
- increasing pro-calcitonin (>2 ng/ml)

If the child is febrile or has other clinical signs of instability, but the IT ratio <0.2 , measure PCT. If the PCT level is <2 ng/ml in children in the PICU, systemic bacterial infection is very unlikely. If the PCT is <2 ng/ml, *don't* start antibiotics...unless there are signs of local infection and antibiotics are indicated (see below), or the child is very unstable.

As it can take 2 hours to get a PCT result, a decision to start antibiotics in a potentially septic child should not be delayed. **So start antibiotics if sepsis suspected, and cease if PCT is <2 ng/ml, or at 48 hours if the cultures are negative.**

Neonatal sepsis

In neonates in the first 48 hours of age, a PCT >10 ng/ml is suggestive of bacterial sepsis. After 3 days of age threshold of >2 ng/ml should be used.

Local infection

PCT is *not* needed to diagnose local infections. In many local infections the PCT range overlaps with the range of PCT in uninfected children in intensive care, so it will not be a strong discriminator of local bacterial infection in this population. Also there are more specific clinical or laboratory signs referable to the site of the local infection (thrombophlebitis, sternal wound inflammation, cellulitis, white cells in urine, new opacity on chest x-ray). If these signs are present local infection is likely. Blood and other cultures should be taken, and the local infection should be treated appropriately (remove the IV drip or catheter, remove the infected sutures, treat the UTI, etc), without the need for using less-specific biomarkers.

Do's and Don'ts

- If antibiotics have been started because of clinical sepsis and a PCT result is <2 ng/ml, consideration should be given to ceasing or scaling back the antibiotics, especially if the cultures are negative at 48 hours.
- Do not order PCT unless (a) there are clinical signs suggestive of infection and (b) you are prepared to withhold, cease, scale back or not escalate antibiotics if the PCT is <2 ng/ml. PCT is *not* a "routine daily screening test" for sepsis.
- Do not order CRP
- Always take blood cultures before starting antibiotics, and where possible a BAL

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References

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