Capillary refill time in sick children

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Abstract

Capillary refill time (CRT) is widely recommended as part of the routine assessment of sick children. Recent systematic reviews have resulted in better understanding of the validity and diagnostic value of this test.
We recommend standardisation of the measurement of capillary refill time. Moderate pressure should be applied to a finger for five seconds, at an ambient temperature of 20-25°C. Capillary refill times of three seconds or more should be considered abnormal.
A prolonged capillary refill time is a specific sign for a range of serious conditions in children, and is appropriate for use as a “red-flag” in primary care. However, a normal capillary refill time (2 seconds or less) has low sensitivity, and so should not be interpreted as a reassuring sign.

Keywords: evidence based medicine, pediatrics, capillary refill, vital signs

Introduction

Capillary refill time (CRT) is a simple and quick test requiring minimal equipment or time to perform. Prolonged capillary refill time is a "red flag" feature, identifying children with increased risk of significant morbidity or mortality.[1,2,4,5] Although national and international guidelines, including NICE guidelines, recommend the use of capillary refill time as part of the initial assessment of unwell children,[1,2] it is infrequently measured in general practice.[3]

What does CRT measure?

As there is no evidence for a relationship between capillary refill time and blood pressure;[6] capillary refill time should not be used as a surrogate for blood pressure in children. There is, however, limited evidence to support a relationship between capillary refill time and arterial blood flow, as well as other invasive cardiovascular parameters, such as superior vena cava oxygenation, and core-peripheral temperature gap.[6] Therefore, capillary refill time is likely to have some value as a measure of peripheral perfusion.

How should CRT be measured?

The choice of site (e.g. finger, hand, foot, or chest) at which capillary refill time is measured can result in significantly different values. Capillary refill time can also be affected by the duration of pressure, and the ambient and skin temperature, with longer duration of pressure and lower temperatures resulting in longer capillary refill times.[6]

The use of a timer to measure CRT is associated with greater inter-observer reliability.[6] Since a timer (e.g. watch) is required for measurement of other

vital signs such as heart rate and respiratory rate, it seems reasonable to recommend its use in the measurement of capillary refill time. A consistent method of CRT measurement should be adopted to ensure that repeated measurements are comparable. We recommend applying moderate pressure for five seconds on the finger (Box 1), a technique which is used in much of the existing literature. We also suggest clinicians understand the upper limit of normal in healthy children.

Measurements of capillary refill time should ideally be documented as a precise time; for example "4 seconds", rather than using ambiguous terminology such as "normal" or "prolonged". Where a cut-off is used, we recommend the use of inclusive textual descriptions, such as "2 seconds or less" or "3 seconds or more". The use of mathematical inequality symbols such as "<2s" or "≥3s" can lead to confusion as measurements are made in whole seconds; this terminology should be avoided.

What is the normal range of CRT in children?

Data on normal ranges of capillary refill time in children are complicated by variations in site and pressing time.[6] In healthy children, a capillary refill time of 2 seconds or less should be expected when measured on the finger. If the foot or chest is used for assessment, capillary refill times of 4 seconds or less should be considered normal. Capillary refill times in neonates (up to 7 days of age), may be longer than in older infants and children, with the upper limit of normal ranging from 5-7 seconds.[6]

There is no evidence that CRT varies significantly with age after the neonatal period. Studies suggest that core temperature does not have a clinically relevant effect on capillary refill time; no correction is required to take account of fever or hypothermia.

Box 1: Recommended measurement method for CRT in children

- Use the finger as the preferred measurement site
- Press for five seconds using moderate pressure
- Ideally, measure at room temperature (20-25°C) irrespective of child's body temperature. Allow time for skin temperature to acclimatise if the child has recently been moved from a warmer or colder environment.
- Use a timer (e.g. watch) to count the seconds it takes for the finger to regain its original colour
- An abnormal CRT in infants and children over 7 days of age is 3 seconds or more; a normal CRT is 2 seconds or less. A CRT measurement of between 2 and 3 seconds may be considered "borderline abnormal", but some healthy children may have CRT as long as 2.5 seconds.
- Record measurements using the actual number of seconds (e.g. "4 seconds" or "2 seconds or less") rather than using terms such as "prolonged" or mathematical symbols.

What is the diagnostic and prognostic value of capillary refill time?

Studies assessing the diagnostic and prognostic value of capillary refill time in children typically use cut-offs of between 2 and 3 seconds to define a "prolonged" measurement. This is consistent with our suggested cut-off of 3 seconds or more to define "abnormal" CRT in infants and children over 7 days of age. Despite widespread use of CRT in primary care, there is very little evidence on the diagnostic or prognostic value of CRT in the primary care setting; recommendations were largely generalised from data obtained in emergency or secondary care.
Studies of children attending Emergency Departments with vomiting and diarrhoea show that prolonged CRT has high specificity of between 88% and 94% for identifying children with moderate dehydration (5% or more).[5] In addition, several studies show that prolonged CRT has high specificity for predicting a variety of serious conditions in children, including meningitis, sepsis, and hypoxia, along with the need for hospital admission. Odds ratios of 2-5 are reported for urinary tract infections and pneumonia, supporting the suggestion that a prolonged CRT is a red flag for serious illness in children, but importantly, a normal CRT does not make a serious illness less likely.[5]

While studies from settings with high mortality (low income or high acuity) show that prolonged CRT is predictive of death, with a specificity of 92% (95% CI 89 – 95%), we do not know if these results apply to children in lower acuity settings.[5] Again, sensitivity was low (35%), meaning that a normal CRT should not be used for reassurance.

Conclusion

A normal CRT test should not be used to rule out serious illness in children. However, a CRT of 3 seconds or more should be considered as a "red flag", indicating that a child is at higher risk of serious illness, because it has high specificity and positive likelihood ratios for a variety of serious outcomes. As there remain some uncertainties around the reliability of CRT measurements, it is appropriate to repeat the measurement of an unexpectedly abnormal CRT, paying particular attention to ensure that it is measured correctly.

Image: Measuring capillary refill time on the finger

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