Phlebotomy Top Gun

Measuring Potassium in Capillary Blood Samples

MAYO CLINIC LABORATORIES

1

Presenter:

Brad Karon, M.D., Ph.D.

Chair, Division of Clinical Core Laboratory Services
Professor of Laboratory Medicine and Pathology

Department of Laboratory Medicine and Pathology
at Mayo Clinic, Rochester, Minnesota

MAYO CLINIC LABORATORIES

2

Disclosures

- None

MAYO CLINIC LABORATORIES

Regarding Capillary compared to Venous potassium (K) measurement, which of the following are true statements?

1. Capillary samples are, on average, more hemolyzed than venous samples, therefore K is systematically higher in capillary samples.
2. For a given amount of free hemoglobin (hemolysis), increase in K is higher in capillary samples.
3. Experienced techs can collect capillary samples with no more free hemoglobin (hemolysis) than a venous sample.
4. 1 and 2 are true.
5. All of the above are true.

MAYO CLINIC LABORATORIES

Capillary Blood

- Mixture of arterial blood, venous blood, and “tissue fluid” (interstitial fluid, fluid leaked from cells during puncture)
- Varying amounts of “tissue fluid” in capillary samples can lead to variability
  - Hemoglobin (none in interstitial fluid)
  - Glucose (delay in transporting glucose after meals)
  - Potassium (K)(?)
- Capillary sampling places more stress on both cells and tissues than venipuncture

Studies of Capillary K[1]

- 40 neonates with arterial line and capillary blood gas and electrolyte measurements
- Capillary K ran 1.2 ± 1.0 higher than arterial line after 2-mL flush
- Capillary K higher than arterial, but why?

Studies of Hemolysis in Capillary Puncture[2]

- Studied mean plasma hemoglobin (Hgb) level in 417 capillary punctures, monolet lancet and lithium heparin microtainer, 15 trained technologists
  - Typical venous free Hgb < 50 mg/dL

Age	n	Mean Hgb
0-13 d	176	390 mg/dL
14 d- 3 mo	47	220 mg/dL
3 mo – 2 yr	49	160 mg/dL
> 2 yr	145	150 mg/dL
Overall	417	260 mg/dL

Studies of Hemolysis in Capillary Puncture[3]

- Studied plasma Hgb level in 151 infant capillary heelstick punctures
  - 45 samples collected by 14 trained outpt phleb (Group 1)
  - 37 samples collected by 5 re-trained outpt phleb (Group 2)
  - 69 samples collected from inpatient nursery (Group 3)
    - Group 1 median Hgb 128 mg/dL
    - Group 2 median Hgb 164 mg/dL
    - Group 3 median Hgb 156 mg/dL
      - Overall mean Hgb 162 mg/dL (no difference between groups)

Effect of Hemolysis on Capillary K[4]

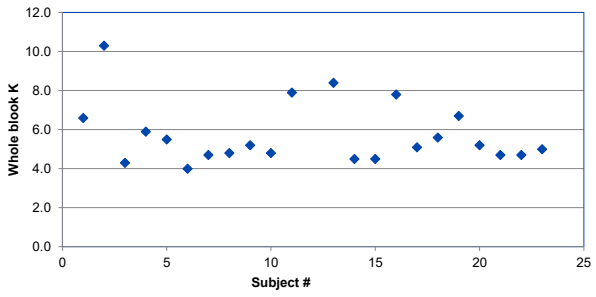
- Compared average K to hemolysis index (semiquant) for 332,760 venous and 2620 capillary samples (ED and ICU excluded)

Venous Samples			Capillary Samples	
H index	% Samples	Avg K	% Samples	Avg K
0	81.1	~ 4.0	37.5	~ 4.0
1	13.6	~ 4.2	42.2	~ 4.5
2	4.3	~ 4.5	10.6	~ 5.0
3	0.4	~ 4.8	3.9	~ 5.2
4	0.2	~ 5.0	2.4	~ 5.5
≥5	0.1	~ 5-6	3.0	~ 6.0

MAYO CLINIC LABORATORIES

Capillary K, Blood Gas Samples

- Mayo Clinic capillary blood gas reference interval study (n=22)
  - Heal warming, capillary tube collections, hand transport



- Mean K = 5.7 mmol/L
- Range 4.0-10.0
- Made decision not to report K with capillary blood gas

MAYO CLINIC LABORATORIES

Capillary K Conclusions

- Capillary samples contain more free hemoglobin (hemolysis) than venipuncture samples
- For a given amount of hemolysis (free hemoglobin), increase in K higher for capillary compared to venous samples
  - Release of K from cells and tissue during capillary puncture?
- Measurement of capillary K best limited to equipment with H index measurement
  - Even then lab should consider different H index cutoff for capillary samples, or apply cutoff strictly

Regarding Capillary compared to Venous potassium (K) measurement, which of the following are true statements?

1. Capillary samples are, on average, more hemolyzed than venous samples, therefore K is systematically higher in capillary samples.
2. For a given amount of free hemoglobin (hemolysis), increase in K is higher in capillary samples.
3. Experienced techs can collect capillary samples with no more free hemoglobin (hemolysis) than a venous sample.
4. 1 and 2 are true.
5. All of the above are true.

References

1. Patel H, Ryan SW, McLain B: Sources of error in neonatal blood sampling. Arch Dis Child 1988;63:752-753
2. Meites S, Lin SS, Thompson C: Studies on the quality of specimens obtained by skin puncture of children. Clin Chem 1981;27(6)875-878
3. Algerciras-Schimnich A, Cook WJ, Milz TC, et al: Evaluation of hemoglobin interference in capillary heel-stick samples collected for determination of neonatal bilirubin. Clin Biochem 2007;40:1311-1316
4. Oostendorp M, van Solinge WW, Kemperman H: Potassium but not locate dehydrogenase elevation due to in vitro hemolysis is higher in capillary than in venous blood samples. Arch Pathol Lab Med 2012;136:1262-1265