High value potassium results

IVD International Clinical Application Department

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K result is too high

Complain from the customer that

Potassium results were too high:

Наименование исследования	Результат	Ед. изм.	Референсные значения
Калий (K+)	8.45	ммоль/л	3.6 - 5.5

Врач-лаборант: Jumaboyev D.

1. Blood was collected in Level med (customer) - outsourced
2. Sample was transported to Intermed
3. Results were sent to the Level med

>>> K clinical application scenario--Hyperkalaemia

Overview

Hyperkalemia is a pathological condition in which the serum potassium concentration is higher than 5.5mmol/L, mainly caused by impaired renal function, potassium overdose, or the use of certain drugs. It is characterized by the disability of in muscles, paralysis, and reduced systolic function of myocardium. **Serious conditions may lead to cardiac arrest.**

98% of potassium is distributed in cells and 2% is distributed outside cells. **Normal blood potassium concentration is 3.5~5.5mmol/L.**

Classified by potassium concentration:

Mild hyperkalemia: 5.5~6.5mmol/L

Moderately high potassium: 6.5~7.5mmol/L

Severe hyperkalemia: >7.5mmol/L

Case Ideas

Check preanalytical stage
-sample tube
-sample transportation conditions

Check analytical stage
1. QC
2. Calibration

Perform additional investigation:
-clinical data of the patient
-more laboratory tests to check the patient's status

Preanalytical stage

Sample came from the laboratory.

1. The tube was RED (with serum activator).
2. Conditions during transportation:
   - Time: 15-20 minutes
   - The test tube was transported vertically in a tripod in a transport bag with refrigerant
3. Storage conditions of the sample at the registration stage: in a tripod at room temperature 20-25 C
4. Centrifugation: 4000 rpm for 10 min, temperature is 22 degrees Celsius

Pretreatment of sample

Before centrifugation

- Do not use glass rods or similar apparatuses to peel away the clot on the tube wall or plug. Manual peeling is a potential cause of hemolysis.
- Keep the tubes closed until you take out the samples after centrifugation.

During centrifugation

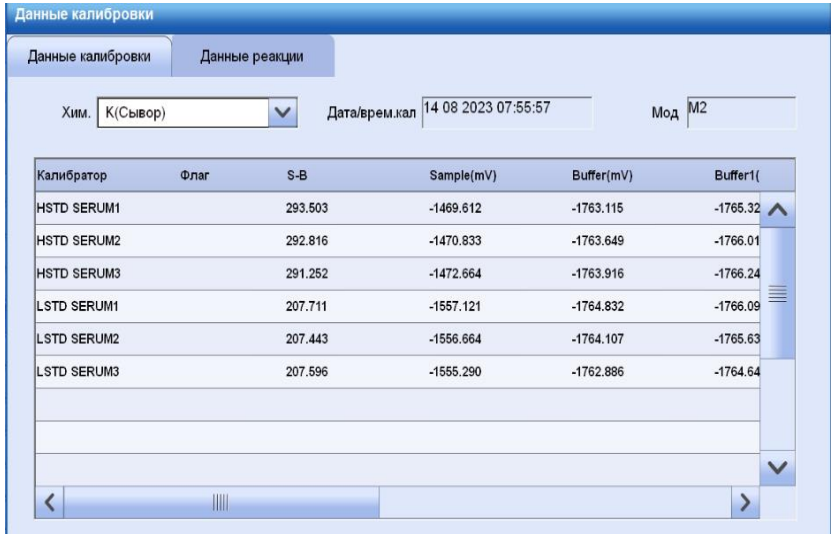
- Centrifugation speed: 1000-3500r/min, 5-10mins;
- Centrifugation temperature: Some temperature-dependent analytes should be separated in 4℃. For analytes without special requirements, set the centrifugation temperature to 20-22 ℃. If the temperature is lower than 15 ℃, the measured value of blood potassium may increase. The refrigerated samples must be centrifuged as required.。
- Re-centrifugation: The centrifugation of the sample should be completed once. If re-centrifugation is required, the centrifugation time should be very short. Do not perform centrifugation if the sample is collected in a blood collection tube containing the separated material.

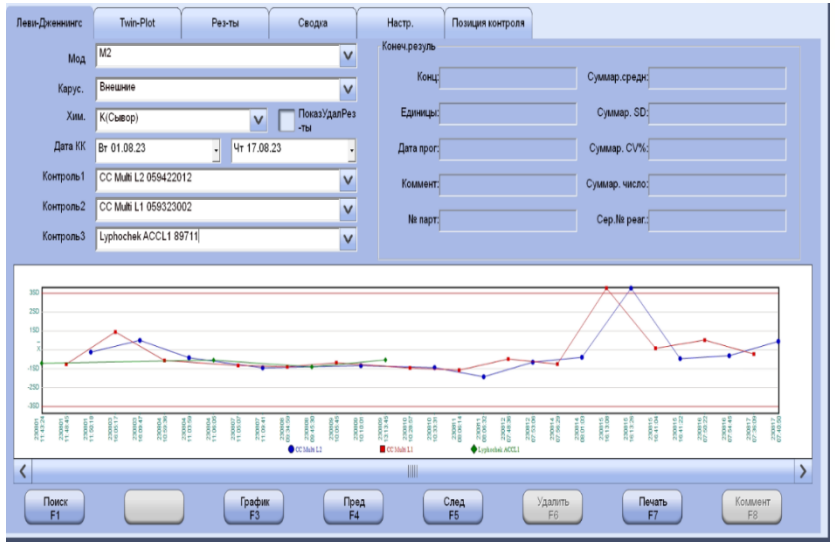
Analytical stage

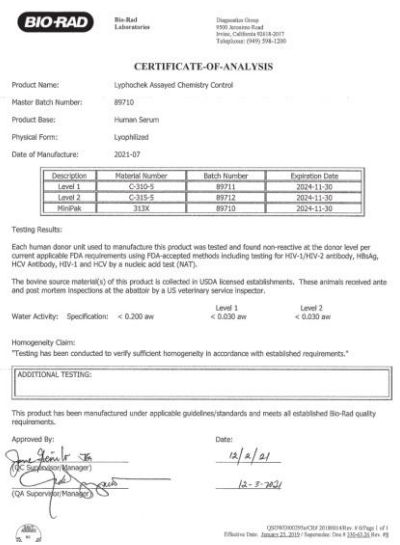
1. The analysis was carried out on MINDRAY SAL9000 (BS-2000).
2. Daily maintenance of the analyzer was carried out before the analysis: Cleaning of electrodes, status: Successful
3. The daily calibration of the electrode was also carried out on the same day, status -Successful
4. QC was performed to check the repeatability – in-control

A&T

- Electrode
- Na, K, Cl and Ref electrodes







EQA participation: EQAS programme – passed

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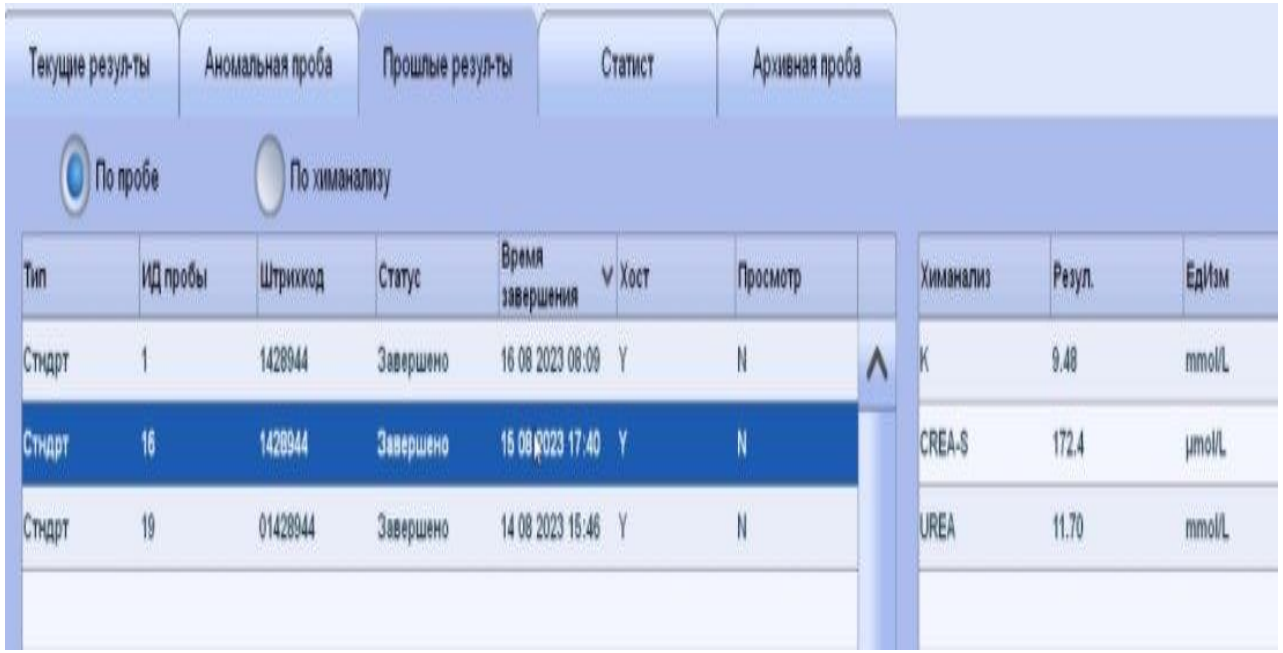
To collect more information about the patient

1. No clinical data was collected from the customer, only demographics:
- Age – 74 years old
- Sex- male

2. If there is no clinical data from the patient, we need to investigate his renal function to understand whether there are other renal parameters are abnormal or not

The sample was rerun for K, Crea-S and Urea tests.



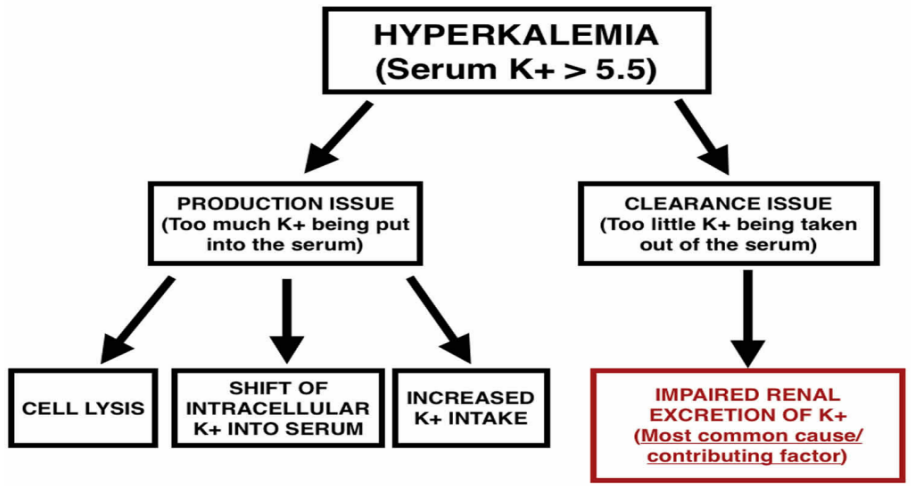
Parameter	Result	Reference range
K	9,48	3,6-5,5
Crea-S	172,4	70-115
Urea	11,70	2,8-7,2

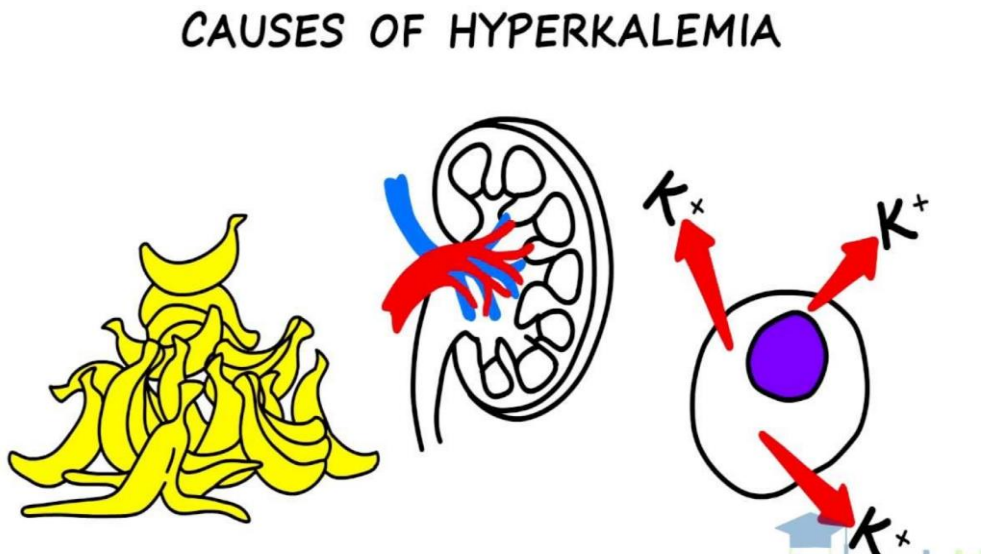
The major parameters that are responsible for renal function are elevated, it means that the patient has renal dysfunction.

What is hyperkalemia?

Causes of Hyperkalemia

- **Pseudohyperkalemia**
  - Hemolysis
  - Thrombocytosis
  - Severe Leukocytosis
  - Fist clenching (venipuncture)
- **Abnormal Potassium Distribution**
  - Insulin Deficiency
  - Beta-blockers
  - Metabolic or respiratory acidosis
  - Familial hyperkalemic periodic paralysis
- **Abnormal Potassium Release from Cells**
  - Rhabdomylosis
  - Tumor Lysis syndrome
- **Decreased Renal Excretion**
  - Acute or Chronic kidney disease
  - Diseases that impact kidney function (e.g., lupus)
  - Aldosterone deficiency
  - Adrenal insufficiency
  - Heart failure
  - Drugs that inhibit potassium excretion





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Pseudohyperkalemia

Pseudohyperkalemia is one of the most common testing errors that occur in the clinical laboratory and obviously should provoke no treatment.
Pseudohyperkalemia is falsely raised serum or plasma potassium concentration. That is, the measured (*in vitro*) value is above the **upper limit of the local reference range** when the actual (*in vivo*) potassium concentration is within the local reference range.

Causes of pseudohyperkalemia:

Poor technique or practice during collection and **preanalytic** processing of blood samples

- Use of narrow-gauge needles
- Use of syringe and needle rather than evacuated tube collection systems
- Sampling blood via iv catheter
- Non-standard (i.e. other than antecubital fossa) venipuncture site
- Prolonged use of tourniquet
- Vigorous shaking of samples after collection
- Transportation of samples via some pneumatic tube transport systems (PTS)
- Long-lasting /excessive centrifugation

Patient conditions that predispose to Pseudohyperkalemia:

- Inherited defects in erythrocyte membrane structure
- Marked increase in platelet count (thrombocytosis)
- Marked increase in white cell count (leukocytosis)

Solution:

Check preanalytic stage:

- ensure to collect samples into right test tube by appropriate blood drawing method √
- the samples should be delivered as fast as possible to avoid hemolysis √

In cases of high potassium concentration, we need to rule out Pseudohyperkalemia:

Check if the patient has Renal failure (chronic or acute) √

Check the sample for

- Thrombocytosis ×
- Leukocytosis ×

The sample came centrifuged and Whole blood sample was unavailable for the cell counting

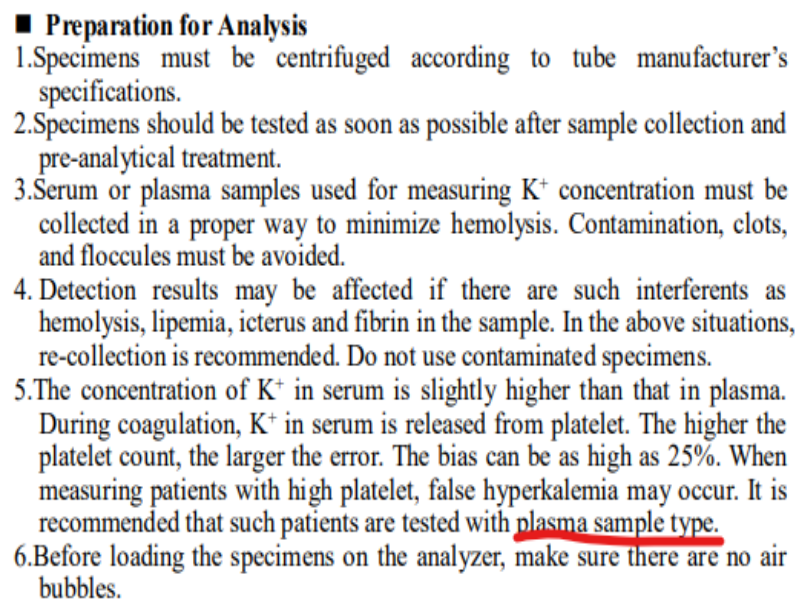
Summary:

In conclusion, due to the data about patient – age (74 years old), Crea and Urea results are high, we can confirm that the Potassium result was CORRECT.

Later, it was found that the patient was in a very serious clinical state and needed to be hospitalized urgently to emergency department.

When we have cases with high potassium results, we need to pay attention to:

1. Routine check of consumables and reagents (expiration date and on-board stability)
2. Quality control: internal QC and EQA are recommended.
3. Calibration: compare with the factory one and judge if there are some serious deviation. It shows precision and accuracy
4. Rule out Pseudohyperkalemia: Exclude wrong pretreatment, leukocytosis and thrombocytosis if possible. Please refer to the K electrode manual
5. Other clinical data such as Renal function parameters of a patient can confirm patient's status and give more information about it.



■ **Preparation for Analysis**

1.Specimens must be centrifuged according to tube manufacturer's specifications.

2.Specimens should be tested as soon as possible after sample collection and pre-analytical treatment.

3.Serum or plasma samples used for measuring K^+ concentration must be collected in a proper way to minimize hemolysis. Contamination, clots, and floccules must be avoided.

4. Detection results may be affected if there are such interferents as hemolysis, lipemia, icterus and fibrin in the sample. In the above situations, re-collection is recommended. Do not use contaminated specimens.

5.The concentration of K^+ in serum is slightly higher than that in plasma. During coagulation, K^+ in serum is released from platelet. The higher the platelet count, the larger the error. The bias can be as high as 25%. When measuring patients with high platelet, false hyperkalemia may occur. It is recommended that such patients are tested with plasma sample type.

6.Before loading the specimens on the analyzer, make sure there are no air bubbles.

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Thanks!

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