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Research Article

# The Difference and Correlation Analysis of Electrolyte and Glucose Concentration Between the Arterial and Venous Blood in Different Age Groups

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## Abstract

**Objective:** To investigate the differences and correlation between the concentrations of electrolytes ($K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$) and glucose (Glu) in venous blood of different age groups.

**Methods:** A total of 106 patients were selected and divided into four groups according to age: < 60 years group (n = 22), 60 - 69 years group (n = 35), 70 - 79 years group (n = 31), ≥ 80 years group (n = 18). The concentrations of $K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$ and Glu in the arterial and venous blood of all patients were detected, and the differences and correlations were analyzed.

**Results:** The detection values of $K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$ and Glu ions in arterial blood were (3.62 ± 0.40) mmol/L, (137.20 ± 3.69) mmol/L, (1.13 ± 0.04) mmol/L, (101.56 ± 3.63) mmol/L, (7.73 ± 3.11) mmol/L, respectively. The detection values of $K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$ and Glu ions in venous blood were (3.86 ± 0.43) mmol/L, (140.69 ± 3.52) mmol/L, (2.17 ± 0.11) mmol/L, (101.22 ± 3.96) mmol/L and (5.34 ± 1.41) mmol/L, respectively. The concentrations of $K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$, and Glu were positively correlated between the arterial and venous blood, and the correlation coefficients were 0.65, 0.64, 0.56, 0.53, and 0.7, respectively. There was no difference in the concentrations of electrolytes and Glu between the four groups of patients with different ages ($P > 0.05$).

**Conclusion:** There are some differences in electrolyte and Glu values between the arterial and venous blood, but there is a positive correlation between them. The arterial blood value can be inferred by venous blood detection. The values of electrolytes and Glu were not affected by age.

***Keywords:*** *Electrolyte; Glucose; Arterial Blood; Venous Blood; Age*

## Introduction

Many clinical diseases can lead to blood electrolyte disorder and glucose fluctuation, affect the normal physiological function of the body, and even endanger life. Blood gas analyzer and automatic biochemical instrument can quickly and conveniently detect the concentration of electrolytes and glucose in patients' blood and venous blood, providing help for clinical diagnosis and treatment. However, there

are some differences in the detection values between the two, which bring some confusion to clinicians in evaluating the condition. This paper analyzes the differences of electrolytes and glucose in the arterial and venous blood of 106 patients, discusses the possible causes and correlation, and analyzes the influence of age on electrolytes and glucose in the arterial and venous blood of patients, so as to help clinicians judge the condition and save the lives of patients.

## Data and Methods

**Research objects and groups:** A total of 106 patients treated in the Department of Respiratory and Critical Care Medicine of the Second Affiliated Hospital of Ningxia Medical University (Yinchuan First People's Hospital) from October 2019 to January 2020 were randomly selected and divided into four groups according to age: < 60 years old group (n = 22), 60 - 69 years old group (n = 35), 70 - 79 years old group (n = 31), and ≥ 80 years old group (n = 18).

**Specimen collection and detection methods:** After admission, 4 - 6 ml arterial blood was collected from the radial artery of all patients with heparin anticoagulant tube, and arterial blood gas analysis was performed with SIEMENS RAPID Point 500 blood gas analyzer, and 5 mL venous blood was collected from the elbow vein of patients with red head tube within 24 hours. The whole blood biochemical test was performed by Beckman Coulter AU5800 automatic biochemical analyzer in hospital laboratory.

**Observation indicators:** The detection results of electrolytes (potassium $K^+$, sodium $Na^+$, calcium $Ca^{2+}$, chloride $Cl^-$) and glucose (Glu) concentrations of all patients were input into EXCEL tables for data analysis and use.

**Statistical methods:** SPSS22.0 For Windows software package was applied, and the collected data were grouped according to the research content. All continuous data in each group were represented by mean ± standard deviation (S ± X), and count data were represented by the number of cases and percentage. One-way analysis of variance (ANOVA) was used for comparison between multiple groups, SNK-Q test was used for comparison between groups, and nonparametric rank-sum test was used for comparison of non-normal or uneven variance data. The detection level of $P < 0.05$ was statistically significant.

## Result

### Comparison of detection results of electrolyte and Glu concentrations between arterial and venous blood

In 106 patients, the cations ($K^+$, $Na^+$, $Ca^{2+}$) in arterial blood were lower than those in venous blood, and the difference was statistically significant ($P < 0.05$). The anion ($Cl^-$) values in venous and arterial blood were similar, and the difference was not statistically significant ($P > 0.05$). Glu detection value in arterial blood was higher than that in venous blood, and the difference was statistically significant ($P < 0.05$) (Table 1).

| Item | Arterial blood | Venous blood | P value |
|---|---|---|---|
| $K^+$ | 3.62 ± 0.40 | 3.86 ± 0.43 | < 0.05 |
| $Na^+$ | 137.20 ± 3.69 | 140.69 ± 3.52 | < 0.05 |
| $Ca^{2+}$ | 1.13 ± 0.04 | 2.17 ± 0.11 | < 0.05 |
| $Cl^-$ | 101.56 ± 3.63 | 101.22 ± 3.96 | > 0.05 |
| Glu | 7.73 ± 3.11 | 5.34 ± 1.41 | < 0.05 |

***Table 1:*** *Comparison of electrolytes and Glu concentrations between arterial and venous blood (mmol/L, x ± s).*

## Correlation analysis of electrolytes and Glu values between arterial and venous blood

The correlation analysis of the electrolytes and GLU values of all the patients included in the study showed that there was a positive correlation between the serum $K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$ and GLU in the kinetic and venous blood (Figure 1-5).

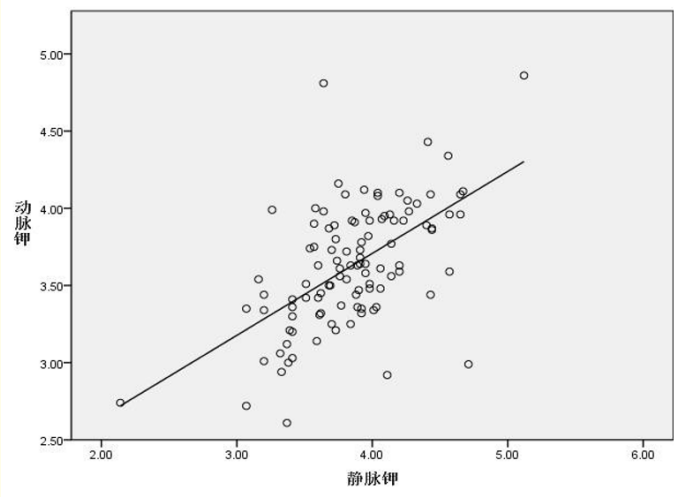


***Figure 1:*** *$K^+$ correlation between arteries.*

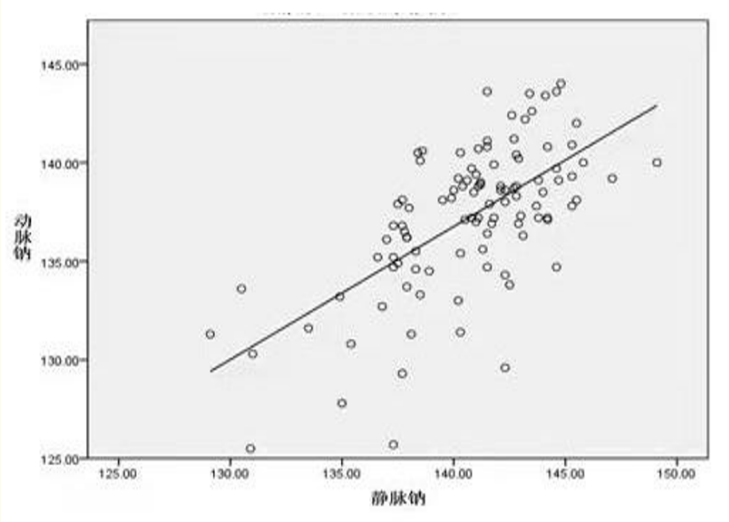


***Figure 2:*** *$Na^+$ correlation between and veins arteries and veins.*

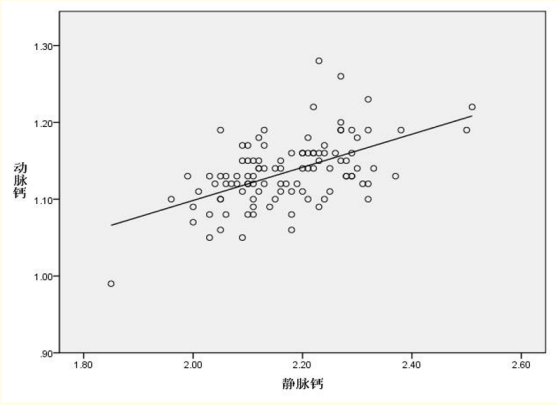


***Figure 3:*** *$Ca^{2+}$ correlation between arteries.*

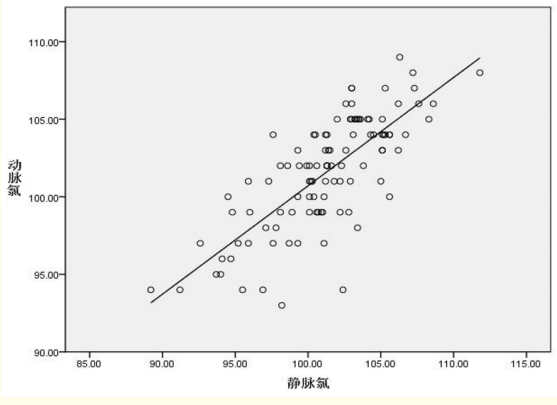


***Figure 4:*** *$Cl^-$ correlation between and veins arteries and veins.*

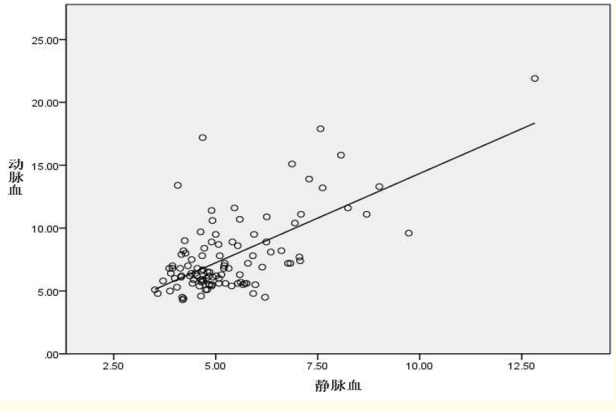


***Figure 5:*** *$Ca^{2+}$ correlation between arteries and veins.*

### Influence of age on electrolytes and Glu detection values in arterial and venous blood

By pairwise comparison of electrolytes and Glu in the arterial and venous blood of patients in four different age groups, it was found that there was no significant difference in the concentrations of electrolytes and Glu between any two groups (P > 0.05).

| Item | ≤60 years old group | 60 - 69 years old group | 70-79 years old group | ≥ 80 years old group | P value |
|---|---|---|---|---|---|
| Arteries Glu mmol/L | 6.23 ± 1.57 | 7.79 ± 3.14 | 8.31 ± 3.08 | 8.2 ± 4.06 | > 0.05 |
| Veins Glu mmol/L | 4.71 ± 0.81 | 5.82 ± 1.85 | 5.42 ± 1.27 | 5.04 ± 0.89 | > 0.05 |
| Arteries $Na^+$ mmol/L | 137.54 ± 4.04 | 137.27 ± 3.77 | 137.13 ± 3.97 | 136.92 ± 2.88 | > 0.05 |
| Veins $Na^+$ mmol/L | 140.56 ± 3.24 | 140.47 ± 3.40 | 141.35 ± 3.49 | 140.07 ± 4.29 | > 0.05 |
| Arteries $K^+$ mmol/L | 3.70 ± 0.33 | 3.53 ± 0.36 | 3.75 ± 0.49 | 3.55 ± 0.36 | > 0.05 |
| Veins $K^+$ mmol/L | 3.90 ± 0.35 | 3.83 ± 0.39 | 3.96 ± 0.46 | 3.65 ± 0.52 | > 0.05 |
| Arteries $Ca^{2+}$ mmol/L | 1.14 ± 0.04 | 1.13 ± 0.05 | 1.14 ± 0.05 | 1.13 ± 0.03 | > 0.05 |
| Veins $Ca^{2+}$ mmol/L | 2.17 ± 0.12 | 2.18 ± 0.12 | 2.18 ± 0.12 | 2.15 ± 0.09 | > 0.05 |
| Arteries $Cl^-$ mmol/L | 102.90 ± 3.52 | 100.94 ± 4.01 | 101.52 ± 3.27 | 101.28 ± 3.51 | > 0.05 |
| Veins $Cl^-$ mmol/L | 102.59 ± 3.29 | 100.70 ± 3.78 | 101.47 ± 4.17 | 100.21 ± 4.56 | > 0.05 |

***Table 2:*** *Comparison of electrolytes and Glu concentrations in the four groups (x ± s).*

## Discussion and Conclusion

**Difference and correlation analysis of electrolytes and Glu between venous and venous blood:** In this paper, we compared the results of electrolytes in the arterial and venous blood of 106 patients, and found that the cations ($K^+$, $Na^+$, $Ca^{2+}$) of arterial blood were lower than those of venous blood, and the difference was statistically significant (P < 0.05). The reasons are as follows: (1) The arterial blood collection vessel is an anticoagulant test tube, and the venous blood collection vessel is a non-anticoagulant test tube. During the process of blood sample examination, the venous blood is prone to coagulation, leading to the destruction of blood cells and the release of intracellular $K^+$ into plasma. In addition, the high-speed centrifugation of venous blood before detection also accelerated the destruction of blood cells and the release of intracellular $K^+$. Secondly, the PH value of venous blood is lower than that of arterial blood and the storage time before detection is longer. Studies have shown that serum $K^+$ increases by 0.6 mmol/L for every 0.1 decrease in PH value [1,2], and serum $K^+$ increases by 2 mmol/L when blood samples are stored at 4°C for 5 hours. (2) The anticoagulant heparin in the arterial blood collection vessel is an acidic mucopolysaccharide, which belongs to an anionic polymer and can bind cationic electrolytes. Therefore, the concentration of cations in arterial blood is lower than that in venous blood, which may be the main reason why the detected value of cations in arterial blood is lower than that in venous blood [3,4].

In this study, it was found that the $Cl^-$ detection values between vascular and venous blood were similar, and the difference was not statistically significant (P > 0.05), which was consistent with the research results of other scholars [5]. The number of study samples could be further expanded for observation and verification in the later period. The detection value of Glu in arterial blood is higher than that in venous blood, which may be related to glycolysis of surviving cells caused by prolonged placement of venous blood before detection, and the longer the placement time, the more obvious the decrease of Glu in venous blood [6-8].

In this study, the correlation analysis of $K^+$, $Na^+$, $Ca^{2+}$, $Cl^-$ and Glu detection values in venous and kinetic blood was conducted, and the results showed that the above indexes were positively correlated with each other. After literature review, this research result was consistent with the conclusion of other scholars [9,10].

### Comparative analysis of electrolytes and Glu in arterial and venous blood of people of different ages

With the growth of age, the organ functions of the body gradually decline, will affect the internal environment of the body to different degrees, so that the whole body changes. A total of 106 subjects were divided into 4 groups according to age. The measured values of electrolytes and Glu in the arterial and venous blood of the 4 groups were compared pairwise. It was found that there was no significant difference in the concentrations of electrolytes and Glu in the arterial and venous blood between any two groups ($P > 0.05$), suggesting that age has no significant effect on the body electrolytes and Glu. The same testing criteria can be applied to people of different ages.

This study showed that although there were some differences in the measured values of electrolytes and Glu between arterial blood and venous blood, there was a positive correlation between them [11]. For primary hospitals lacking facilities and equipment, the change trend of the measured values of venous blood could be used to predict the condition of arterial blood, so as to assist in judging the disease change and guide clinical treatment.

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