

Original Article

Comparing the Accuracy of the Flowmeter in Calculating the Amount of Fluid Intake with Conventional Prescription of Fluids by Nurses in Cardiovascular Disease Patients

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Abstract

Background: The importance of balancing fluid and serum electrolytes in critically ill patients necessitates the exact calculation of the intravenous fluid intake in this group. In the present study, the accuracy of this approach in calculating the amount of fluid intake in patients with cardiovascular disorders was compared with that of the flowmeter.

Methods: This cross-sectional study was performed on 36 consecutive patients hospitalized in the CCU of Rajaie Cardiovascular, Medical and Research Center (Tehran, Iran) because of evident cardiovascular disorders. The amount of received intravenous fluid was measured by the flowmeter and by nurses using conventional prescription methods simultaneously.

Results: The difference between the flowmeter values and gold standard values was not significant (776.11 ± 39.75 vs. 764.97 ± 37.94 , mean difference = -11.14 ± 44.51 ; p value = 0.142), whereas there was a significant difference between the nurses' recordings and the gold standard values (p value < 0.001). Also, the difference between the values measured by the nurses and those recorded by the flowmeter was slightly significant (mean difference = 4.944, SD = 14.873; p value = 0.054).

Conclusion: The intravenous measurement of fluid intake via the flowmeter can be considered equivalent to the gold standard, and it can lead to a decrease in biases and side effects of treatment protocols. (*Iranian Heart Journal 2015; 16(1): 34-37*)

Keywords: ■Flowmeter; ■IV fluid intake; ■Calculating; ■Cardiovascular disease

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Because balancing fluids and serum electrolytes in patients, especially cardiac, renal, surgical, or critical patients admitted to the Intensive Care Unit, can have a significant impact on the treatment outcome,¹⁻³ the exact calculation of the intravenous fluid intake in these patients is important. Moreover, in most cases, it is impossible to accurately calculate the received intravenous fluid and to precisely implement the physician's order due to a lack of facilities.^{4,5} In such circumstances, the nurse follows the order of the physician based on the numbers listed, which may increase complications related to inappropriate treatment with intravenous fluids.⁶⁻⁸

In the present study, the accuracy of this approach in calculating the amount of fluid intake in patients with cardiovascular disorders was compared with that of the flowmeter.

Methods

This cross-sectional study was performed on 36 consecutive patients hospitalized in the Coronary Care Unit of Rajaie Cardiovascular, Medical and Research Center because of evident cardiovascular disorders. Each patient's fluid intake prescribed by the physicians was evaluated by one intern for an 8-hour period. The patients received a certain amount of intravenous fluid routinely by nurses and based on physicians' instructions. Simultaneously, the received intravenous fluid was also measured using the flowmeter. Also, the weight of the serum was measured using a digital scale for each patient before and after the infusion, and the difference between the two measures was considered the gold standard for the patient's fluid intake. The nurse error rate was considered the difference between the gold standard value and the amount of fluid recorded by the nurse. Also, the error rate of the flowmeter was considered the difference between the gold standard value and the value registered by the flowmeter. It should be noted that the study

was performed using a single digital scale and a single flowmeter. Also, one physician was responsible for the installation and reading the flowmeter value and, thus, the nurses were unaware of the flowmeter results.

The results are presented as mean±standard deviation (SD) for the quantitative variables. The continuous variables were compared using the *t*-test or non-parametric Mann-Whitney U test. For the statistical analysis, the statistical software SPSS (version 20.0) for Windows (SPSS Inc., Chicago, IL) was used. A *p* value≤0.05 was considered statistically significant.

Results

In 33 out of the 36 patients included, the amount of fluid recorded by the flowmeter was higher than the value recorded by the nurses. In other words, only in 3 patients was the value recorded by the nurses higher than that recorded by the flowmeter. The error rate was 48.13ml in the nurses' recordings and 43.19ml in the flowmeter. The difference between the values calculated by the flowmeter and the gold standard values was not significant (776.11 ± 39.75 vs. 764.97 ± 37.94 , mean difference = -11.14 ± 44.51 ; *p* value = 0.142), while there was a significant difference between the nurses' recordings and the gold standard values (*p* value < 0.001). Also, the difference between the values measured by the nurses and those recorded by the flowmeter was slightly significant (mean difference = 4.944, SD = 14.873; *p* value = 0.054).

Discussion

Because all the patients in the present study were hospitalized due to underlying cardiovascular disorders, the probable bias related to the effect of the type of disease was not proposed. Also, because all the nurses worked in a similar shift and also because the setting-up, reading, and recording of the values on the flowmeter as well as data entry were performed by a single operator, the

operator-related bias was also minimized. Moreover, all the nurses were unaware of the values calculated by the flowmeter. Also, because a single flowmeter and also a single digital scale were applied for all the patients, the bias due to the structural changes in instruments also did not exist. Each patient was evaluated for 8 consecutive hours: the considered duration was acceptable to reduce biases. According to the obtained results, the values measured via the flowmeter were comparable with the gold standard values; accordingly, the device has a very high accuracy and can be regarded as equivalent to the gold standard. In contrast, the values recorded by the nurses were different from the gold standard values.

Because only one flowmeter device was available and also each patient was connected to the device for 8 hours, the increase in sample size was impossible. However, we found the values of the flowmeter very close to the gold standard values.

Recent studies have shown that unlike in the past, especially in critically ill conditions, patients should not receive intravenous fluids without calculation and restriction.^{9,10} On the other hand, the computational errors in the measurement of fluids, including common errors, lead to complications in patients.^{11,12} Unfortunately, the methods for the measurement of intravenous fluids have been very inaccurate and inefficient⁷ or are not applicable to all patients owing to their high complexity.¹³ Nonetheless, the simplicity and high precision of the flowmeter for intravenous fluid intake makes it suitable for wide use with a view to preventing the avoidable complications of such intake.

Conclusion

The intravenous measurement of fluids using the flowmeter can be considered equivalent to the gold standard and can reduce biases and side effects of treatment protocols. This method of measurement, not least in patients

who are more vulnerable to the imbalance of fluids and electrolytes, can be crucial and can effectively improve the outcomes of treatment.

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