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A comparison of prognostic significance of strong ion gap with base excess and anion gap in patients with pesticide intoxication

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Objectives: There are three representative approaches in acid-base disorders, including the physiologic, base-excess (BE), and physicochemical approach (also called Stewart method). These methods were validated to predict mortality in critically ill patients. However, the predictability of the physicochemical approach for patients' death was not evaluated in patients with pesticide.

Methods: The patients with pesticide intoxication who visited Soonchunhyang University Cheonan Hospital from January 2015 to December 2019 were enrolled. Among them, patients intoxicated with paraquat were excluded. Anion gap (AG) corrected for albumin, BE, and strong ion gap (SIG) were collected to represent the physiologic, BE, and physicochemical approach, respectively. The area under the curve (AUC) of each parameter to predict patients' death was calculated, and receiving operating characteristic (ROC) curves were drawn. AUC of the parameters was compared using the Delong method. Additionally, the optimal cut-off point was decided based on the Youden index, and subsequently, sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were calculated.

Results: A total of 952 patients visited our center during the period because of pesticide intoxication. Among them, 131 patients were excluded because of paraquat ingestion. Then, seven patients were excluded due to a lack of BE data. Eventually, 821 patients were analyzed, and 77 patients were dead. No one died in 7 patients who lack data of BE. BE showed the highest AUC [0.817 (0.789 – 0.843)], and AG was next [0.803 (0.774 – 0.830)]. SIG showed lowest AUC [0.757 (0.726 – 0.786)] (Figure 1 and Table 1). BE showed the best performance in accuracy and specificity, and AG showed best in sensitivity (Table 1).

Conclusions: BE and AG showed superior performance than SIG for predicting mortality in patients with pesticide intoxication.

Table 1

Table 1. The area under the curve and confusion matrix of base excess, anion gap, and strong ion gap to predict patients' death in patients with pesticide intoxication.

Parameters	AUC	P-value	Cut-off	Sensitivity	Specificity	PPV	NPV	Accuracy
BE	0.817 (0.789 – 0.843)	< 0.001	≤ -8.1	66.2 %	85.9 %	32.7 %	96.1 %	84.0 %
AG ^a	0.803 (0.774 – 0.830)	< 0.001	> 18.2	71.4 %	79.0 %	26.1 %	96.4 %	78.3 %
SIG ^b	0.757 (0.726 – 0.786)	< 0.001	> 19.0	71.5 %	71.8 %	22.0 %	96.1 %	73.6 %

Note: There were statistically significance in pairwise comparison of receiving operation characteristic curves between BE and SIG ($p = 0.012$), and AG and SIG ($p = 0.001$).

Abbreviations: BA, base excess; AG, anion gap; SIG, strong ion gap; AUC, area under the curve; PPV, positive predictive value; NPV, negative predictive value.

^a Anion gap was corrected for albumin, $AG = ([Na^+] - ([Cl^-] + [TCO_2])) + (2.5 \times (4 - \text{albumin, g/L}))$.

^b SIG = apparent strong ion difference (SIDa) – effective strong ion difference (SIDE); $SIDa = ([Na^+] + [K^+]) - [Cl^-]$; $SIDE = [HCO_3^-] + [Alb^-] + [P_i^-]$, where: [Alb] [Albumin, g/L] $\times [(0.123 \times pH) - 0.631]$; $[P_i^-] = [\text{phosphate, mmol/L}] \times [(0.309 \times pH) - 0.469]$.

Figure 1

Figure 1. Receiving operator characteristic curves of the base excess, anion gap, and strong ion gap.

