The Frequency of the Causes of Acid Base Disturbances in Patients Hospitalized in the Toxicology Ward of Baharloo Hospital in 2009

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ABSTRACT

Background: The aim of this study was to evaluate the efficacy of arterial blood gases (ABGs) in determining the type of intoxication.

Methods: Medical charts of all patients who had referred to the toxicology ward of Baharloo Hospital between January 2009 and December 2009 were evaluated. After excluding the patients with multi-drug toxicity, data, including age, sex, type of intoxication (the medication ingested), ABG options, including pH, pco2, Hco3, and the type of acid-base disturbance were collected and recorded in a self-made questionnaire. Data were analyzed using SPSS version 11.

Results: Of the 1570 cases evaluated, 807(51.4%) were male and 763(48.6%) were female. Most of the patients were 20 to 29 years old (554 patients; 35.3%). Arterial blood gases were normal in 578 (36.8%) patients. Metabolic acidosis, respiratory acidosis, respiratory alkalosis, mixed acidosis, and mixed alkalosis were detected in 434(27.6%), 292(18.6%), 177(11.3%), 60 (3.8%), and 29(1.8%) patients, respectively. Pure metabolic alkalosis was not detected in any of the patients. The toxins were classified into 18 groups with opium/opioids, acetaminophen/NSAIDS, and antidepressants and anticonvulsants being the most common toxicities.

Conclusion: Although metabolic acidosis may not be helpful in diagnosis of the type of intoxication, respiratory and mixed acidosis as well as mixed alkalosis may indicate special types of intoxication. This may help faster diagnosis and reduce the mortality and morbidity of the patients.

Keywords: Acid-base Disturbances, Diagnosis, Intoxication.

INTRODUCTION

Many drugs and medications cause acid-base disturbances. Evaluation of arterial blood gases (ABG) is very helpful in determination of the type of intoxication and its treatment. Each drug category causes a specific type of acid-base disturbance which as mentioned, helps in determination of the intoxication type in a suicidal patient who is under the effect of a drug and his/her responses are inaccurate or misguiding. Also, in a suicidal patient who ingests the drugs due to emotional stress, he may not remember what he has ingested after referring to the hospital, or he may be found in coma and not be able to provide the proper history. Therefore, we tried to use a simple and available paraclinical tool (i.e. ABG) for determining appropriate diagnoses in intoxicated patients and diagnose the patients' toxidrome using this tool as well as other physical and paraclinical methods for a better and faster treatment.

MATERIALS AND METHODS

In this cross-sectional, descriptive study, the medical charts of all patients who had referred to the emergency room, toxicology ward, and toxicology ICU of Baharloo Hospital between January 2009 and December 2009 were evaluated. Data including age, sex, type of intoxication (the medication ingested), arterial blood gas (ABG) options including pH, pco2, Hco3, and the type of acid-base disturbance were collected and recorded in a

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self-made questionnaire. All patients with multi-drug intoxication were excluded from the study. Data was analyzed using SPSS version 11.

RESULTS

Of 1570 cases evaluated, 807(51.4%) were male and 763(48.6%) were female. Mean age was 31.58±0.48 and 36.04±0.49 in women and men, respectively. Most of the patients were in the 20 to 29 year old age group [554 patients(35.3%)] and the least were in the age range of 60 years and over [59(3.8%)]. Arterial blood gases were evaluated in all of these patients and were normal in 578 (36.8%) patients. Metabolic acidosis, respiratory acidosis, respiratory alkalosis, mixed acidosis, and mixed alkalosis were detected in 434(27.6%), 292(18.6%), 177(11.3%), 60

(3.8%), and 29 (1.8%) patients, respectively. Pure metabolic alkalosis was not detected in any of the patients. The toxins were classified into 18 groups as follows: opium/opioids in 383(24.4%), acetaminophen in 205(13.1%), antidepressants and anticonvulsants in 190 (12.1%), benzodiazepines in 173 (11.0%), antihypertensives in 85 (5.4%), alminium phosphide (Alp) in 73(4.6%), anti-diabetics in 73(4.6%), amphetamine-like drugs in 72 (4.6%), antipsychotics in 57 (3.6%), nontoxic alcohols in 42(2.7%),metals in 42(2.7%), carbon monoxide (CO) in 30 (1.9%), salycilates in 29 (1.8%), organophosphates in 29 (1.8%), toxic alcohols in 29 (1.8%), detergents in 29 (1.8%), caustics in 15 (1.0%), and bites in 14 (0.9%) patients. Details of the ABG changes in each group are presented in Table 1.

Table 1. ABG changes in each group of intoxication (Numbers in parenthesis are percents)

Acid base abnormality / Drug/toxin type	Metabolic acidosis	Respiratory acidosis	Respiratory alkalosis	Mixed acidosis	Mixed alkalosis	Normal ABG
Opium/opioids	45(11.7)	249(65)	0	45(11.7)	0	44(11.5)
Acetaminophen/ NSAIDs	15(7.3)	0	74(36.1)	0	0	116(56.6)
Antidepressants/ anticonvulsives	15(7.9)	14(7.4)	0	15(7.9)	15(7.9)	131(68.9)
Benzodiazepines	0	29(16.8)	0	0	0	144(83.2)
Antihypertensives	42(49.4)	0	0	14(16.5)	0	29(34.1)
Alminium Phosphide	73(100)	0	0	0	0	0
Antidiabetics	43(58.9)	0	30(41.1)	0	0	0
Amphetamine like drugs	0	0	44(61.1)	0	0	28(38.9)
Antipsychotics	14(24.6)	0	14(24.6)	0	0	29(50.9)
Nontoxic alcohols	14(33.3)	0	0	0	0	28(66.7)
Metals (Iron)	42(100)	0	0	0	0	0
CO	15(50)	0	15(50)	0	0	0
Salycilates	29(100)	0	0	0	0	0
Organophosphates	29(100)	0	0	0	0	0
Toxic alcohols	29(100)	0	0	0	0	0
Detergents	0	0	0	0	0	29(100)
Caustics	15(100)	0	0	0	0	0
Bites	14(100)	0	0	0	0	0

DISCUSSION

The toxins were classified into 18 groups and the most common cause of drug intoxication was opium/opioid in 383(24.4%) patients. Mean age of the patients in this group was 40.57 years and 85% of them were male.

Analysis of ABG in our study showed that ABG values of the intoxicated patients were mostly normal (578 patients; 36.8%). Metabolic acidosis was the most common acid-base abnormality which was detected in 434 (27.6%) patients followed by respiratory acidosis, mixed acidosis, and mixed alkalosis in 292(18.6%), 60(3.8%), and 29(1.8%) patients, respectively.

In the opium/opioid group, respiratory acidosis was present in 65% of the patients. As it is widely known, hypoventilation due to opium overdose is one of the cornerstones of the diagnosis of this type of intoxication (well-known triad of hypoventilation, decreased level of consciousness, and myosis) (1). Clinically, respiratory acidosis following increased PCO2 may indicate respiratory failure in these patients and the need for assisted ventilation. This is in accordance with Meredith's study in which the intoxication of the narcotics was compared with that of non-narcotic painkillers that showed narcotics were significantly more related to respiratory acidosis (1).

Benzodiazepines provoke a decreased level of consciousness and drowsiness by acting on GABA receptors but they do not induce respiratory and hemodynamic disturbances except in high doses. In high doses and intoxication with short-term products such as midazolam, there is the probability of decreased ventilation, increased PCO2, and respiratory acidosis (1). In our study, 144 patients in this group had normal ABG (83.2%) and did not need respiratory support. In the rest 29 (16.8%) patients, respiratory acidosis developed, and therefore, these patients needed mechanical ventilation for protection of the respiratory airways and sufficient ventilation.

Anti-hypertensive medications affect the pumping function of the heart and result in the dilatation of the vascular system, reduced tissue perfusion, and lactic acidosis. In our study, 29

(34.1%) of these patients had normal ABG and 42 (94.4%) of them presented metabolic acidosis.

Alminium phosphide releases phosphine in contact with water and acid in the stomach. Phosphine disables the cells respiration system by blocking the cytochrom oxidase C and chain of electron transportation and eventually, results in loss of ATP formation and severe metabolic acidosis. In our study, all 73 patients with Alp intoxication developed metabolic acidosis.

The most commonly used anti-diabetics in Iran are glybenclamide and metformin. Glybenclamide induces a more severe hypoglycemia, which can cause agitation, tachypnea, tachycardia, and respiratory alkalosis in ABG. Metformin causes a less severe hypoglycemia but results in lactic acidosis with high anion gap (2). In the present study, of the total 73 patients with this type of intoxication, 30 (41.1%) experienced respiratory alkalosis and 43 (58.9%) had metabolic acidosis. In the study by Change et al, 74% of the patients with metformin intoxication had metabolic acidosis with high anion gap (3).

Nontoxic alcohol (ethanol) firstly causes increased reaction time and incoordination of the muscles. In serum level of 150 to 300 mg/dL, dysarthria, ataxia, and diplopia develop. When this reaches 300-500 mg/dL, hypotonia, stupor, coma, and metabolic acidosis occur. In doses higher than 500mg/dL, hypotension, respiratory depression, and failure of circulation ensue (4,5).

In this study, 28 (66.7%) patients with ethanol intoxication had normal ABG and 14(33.3%) had metabolic acidosis. In Brooks and Wallace's study, 72.8% of these patients had normal ABG, while 27.2% had metabolic acidosis (6).

Iron is corrosive and causes cellular toxicity. Ferrous (Fe2+) oxidation in the gastrointestinal system forms ferric iron (Fe3+), three hydrogen atoms, and metabolic acidosis. Additionally, iron causes mitochondrial dysfunction, respiratory failure, and lactic acidosis.(7) In this study, all 42

patients with iron toxicity had metabolic acidosis.

Salycilates are hydrolyzed to acetate and salicilic acid after absorption. In the early stages, triggering the respiratory center causes hyperventilation and respiratory alkalosis, failure of the cellular oxidative phosphorilation, and high anion gap metabolic acidosis (4,8-11). In our study, all of the 29 patients intoxicated with aspirin had metabolic acidosis which is in accordance with the results obtained by Bartels (12). In Brenner's study, 86.8% of the cases had metabolic acidosis with high anion gap (9). Chronic intoxication is common in elderly and mimics the clinical features of other pathological conditions such as sepsis, encephalopathy, respiratory failure, and delirium. In this situation, the presence of high anion gap metabolic acidosis helps the diagnosis and guides the physician to evaluate the serum level of the drug and urine analysis regarding pH and ketones.

Toxic alcohols which cause intoxication are methanol and ethylene glycol. Methanol is converted to formaldehyde (by alcohol dehydrogenase) and then, to acid formic which is the main cause of the clinical features of methanol intoxication, including high anion gap metabolic acidosis. Osmolal gap also increases. Combined metabolic acidosis with high anion gap and high osmolal gap strongly suggest methanol or ethylene glycol toxicity (5, 6,8). In the present study, all of the 29 patients with methanol toxicity had metabolic acidosis. In Fujita and associates' study, 93% of the patients had metabolic acidosis (5).

Intoxication with paracetamol (acetaminophen) and NSAIDs in high doses can result in metabolic acidosis (1,13). In our study, of the total 205 patients with this type of toxicity, 116 (56.6%), 15(17.3%), and 74(36.1%) had normal ABG, metabolic acidosis, and respiratory alkalosis, respectively. In Lamkin and Fraiz's study, 64% of the patients intoxicated with NSAIDs had normal ABG and 36% had metabolic acidosis (14). Also, in Grey and Buckley's study, 48% of the patients with paracetamol toxicity had normal ABG, whereas 8.4% of them had metabolic

acidosis and 43.6% had respiratory alkalosis (13).

Our results show that in patients with decreased level of consciousness, intact gag reflex and normal ABG, and positive urinary screen tests for benzodiazepines, emergent intubation and other invasive treatment procedures are not needed and supportive treatment suffices.

According to our results, almost all patients with toxic alcohol, Alp, salicylate, and iron intoxication had severe metabolic acidosis. Overall, most of the patients with abnormal ABG had metabolic acidosis. Respiratory acidosis was only present in the patients with opium/opioid, antidepressant/anticonvulsant, and benzodiazepine intoxications. Mixed acidosis was detected in three groups, including opium/opioid, antidepressant/anticonvulsant, and anti-hypertensive drugs. Mixed alkalosis was only present in the patients with antidepressant/anticonvulsant toxicity. It can be concluded that although metabolic acidosis may not be helpful in the diagnosis of the type of intoxication, respiratory and mixed acidosis as well as mixed alkalosis may indicate special types of intoxication. This may help the physician to decide quicker and reduce the mortality and morbidity of the patients.

CONCLUSION

It can be concluded that for every patient referring to the emergency room with unknown history or decreased level of consciousness and high anion gap metabolic acidosis, intoxication, especially that with toxic alcohols, Alp, salicylates, and iron should be suspected. Respiratory and mixed acidosis as well as mixed alkalosis may indicate special types of intoxication. This may help reduce the mortality and morbidity of the patient.

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