ORIGINAL ARTICLE

Patterns of Acid Base Balance and Plasma Electrolyte Concentrations in Post Surgical Digestive Patients

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Abstract. Patterns of acid-base balance and plasma electrolyte concentrations of postsurgical digestive patients were studied retrospectively. The patients were treated at the Pediatric ICU Dr. Pirngadi Hospital, Medan, during the period of February 1991 through January 31 1992. There were 131 patients admitted to the Pediatric ICU, 67 (51.1%) of them had had gastrointestinal surgery. Arterial blood gas and / or plasma electrolyte examinations were done in 92% of patients within 12 hours of admission. In 50 patients both blood gas and electrolyte concentration values were examined; 6 of them died. One out of 14 patients who had only serum electrolyte concentration values died. One out of 3 patients who had neither blood gas nor plasma electrolyte concentration values died. Acid-base imbalances were found in 66% of those 50 patients, consisting of 28% metabolic acidosis, 12% respiratory alkalosis, 8% respiratory acidosis, and 6% metabolic alkalosis. Hyponatremia was found in 68.4% of the survivors and in 2 out of 6 patients who died. No hypernatremia was found in any of the patients. Hypokalemia was found in 24.6% of patients survived; and none in those who died. Hyperkalemia was encountered in 24.6% of those who survived. The overall mortality of patients who had undergone gastrointestinal surgery in the Pediatric ICU, Pirngadi Hospital, was 8/67 (11.9%). **[Paediatr Indones 1993; 33: 173-81]**.

Introduction

The management of postsurgical patients has improved in the last decade as a result of several factors such as the development of intensive care units, advances in homeostatic monitoring system, and the application of mandatory ventilation.[1] Many of those patients develop physiological alterations, either because of the preexisting disease, or as the complication of surgical procedures, or both. Arterial blood gas analysis and serum electrolyte examinations may reveal the specific physiological alterations, i.e. metabolic disorder due to defective metabolism, or respiratory disorder due to respiratory or circulatory problems.[2,3] However, it should be kept in mind that the diagnosis could not be made only on the basis of

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Table 1. Distribution of cases by age and sex

Age (Years	Recovered			Expired		
	Boy	Girl	Total	Boy	Girl	Total
-1	25	7	32	3	2	5
-2	3	-	3	-	-	-
-3	-	-	-	-	-	-
-4	3	-	3	-	-	-
-5	1	-	1	1	-	1
>5	14	6	20	2	-	2
Total	46	13	59	6	2	8

Table 2. Acid base balance in 50 post surgical digestive cases

	Recovered	Expired
No. of cases	44	6
Normal balance	15	-
Acid base imbalance	-	-
Metabolic acidosis	12	-
Respiratory acidosis	4	1
Metabolic alkalosis	3	
Respiratory alkalosis	12	2

Table 3. Distribution of pH value in both groups

pH	Recovered	Expired
< 7.20	2	2
7.20 -	8	2
7.30 -	13	-
7.40 -	14	2
≥7.50	7	-

Table 4. Distribution of pCO_2 value in both groups

pCO_2 (mmHg)	Recovered	Expired
< 15	5	-
15 -	5	1
25 -	20	1
35 -	7	2
45 -	6	1
≥ 55	1	1

Table 5. Distribution of base excess value in both groups

Base excess (meq/L)	Recovered	Expired
≤ 20	9	2
- 20 -	26	3
- 10 -	2	-
0 -	7	1
10 -	-	-
≥ 20	-	-

Table 6. Distribution of serum Na^+ concentration in both groups

Na^+ (meq/L)	Recovered	Expired
< 110	-	1
110 -	9	1
120 -	30	4
130 -	17	-
140 -	1	1
150 -	-	-
≥ 160	-	-

Table 7. Distribution of serum K^+ concentration in both groups

K^+ (meq/L)	Recovered	Expired
< 3.5	-	1
3.5 - 4.5	9	1
≥ 4.5	30	4

5.0 mEq/L was noted among in 14/57 survivors, and in 4/7 of cases who died.

In this study 7 out of 8 cases who died had hyponatremia and 4 out of 6 whom the pH value was available showed low pH values. Only 1 case developed hypokalemia. The average duration of hospitalization was 42.75 hours.

Table 8. Distribution of expired cases by age, sex, acid base and electrolyte status and duration of hospitalization

No.	Age	Sex	pH	pCO_2 (mmHg)	Base excess	Na^+ (meq/L)	K^+ (meq/L)	Length of hospitalization (hours)
1	3 days	Girl	7.08	49.4	-16.4	126	4.61	42
2	5 days	Girl	-	-	-	109	5.36	4
3	8 days	Boy	7.24	41.1	-9	104	3.95	44
4	5.5 mos	Boy	7.25	40.1	-9.7	121	5.24	56
5	7 mos	Boy	-	-	-	-	-	4
6	5 yrs	Boy	7.42	28.5	-5.2	129	3.91-	98
7	7 yrs	Boy	6.92	89.8	-14.9	128	3.72	3
8	11 yrs	Boy	7.41	38.4	0.8	142	2.02	91

Discussion

The management of fluid, electrolytes, and acid base imbalances is important and is related and influencing each other. When the body is in disequilibrium, it basically takes two actions; H makes internal adjusment to either the losses or excessive and regulates it. Its products of excretion (expired air and urine) increase or decrease either the fluid, electrolyte and acids or bases. They are evidence of the return of the body to its normal acid base balance and fluid and electrolyte composition.[1,2]

The volume and characteristic of gastrointestinal losses may be partly assessed on the basis of the history and observation of diarrhea, stool and vomiting. The electrolyte composition of vomited fluid depends on the level of obstruction. Pure gastric juice vomited by an infant with hypertrophic pyloric stenosis usually contains 120-140 mEq Cl/L, 10-12 mEq K+, and 60-75 mEq Na^+. On the other hand, bile and pancreatic juice contain 120-140 mEq sodium, up to 100 mEq Cl, and approximately 10-12 mEq K^+/L. In distal obstruction given lactated Ringer solution, one may find losses of 3.5 - 4.5 g protein/100 ml of peritoneal fluid leading to acid base imbalance and electrolyte cases with disturbances. Those disturbances needs optimum replacement and maintenance therapy before and during

operation to prevent further post operative complication.[8]

Abnormalities found in the present study were metabolic acidosis and hyponatremia in recovered or expired cases and hypokalemia in recovered cases. There was not any hypernatremia at all found in either group. Hyperkalemia in those who died may be due to the influence of previous metabolic acidosis which was dominant in that group. These conditions were related with the pre or during operative condition of the patient. Acid base and electrolyte imbalance in patients with digestive surgical cases preoperatively, was frequently due to the high acid base and electrolyte content as a result of vomiting. The fasting patients prior to the digestive surgery, might lead to the evident of fluid, acid base and electrolyte imbalance. Significant losses of fluid, electrolyte, and protein due to fasting patients is described in the Table 9.

The increased metabolic rate and body temperature influence acid base balance and serum electrolyte concentration. Inappropriate resuscitation during operative period may lead the patients into hypoxia and hemorrhage which release various component influencing the acid base and electrolyte balances. This problem could be prevented by maintaining baseline requirement and replacing fluid and electrolyte abnormalities before and during the surgical procedure.

Table 9. Losses of fluid, Na^+, K^+, carbohydrate, and protein in an hour of fasting

Body component	Losses per hour
H_2O	60 ml
Na^+	1.8 meq/L
K^+	2.1 meq/L
Protein	6.1 g
Carbohydrate	2.6 g
Fat	5.6 g

Conclusions

Acid base and electrolyte imbalances were frequently encountered in patients who had undergone surgery for gastrointestinal disease. Adequate management of acid base balance, fluid volume, and electrolyte concentration before and during operation is very important to prevent postoperative acid base and electrolyte imbalances. Further studies on early detection and management of acid base and electrolyte disturbances in patients undergoing gastrointestinal surgery are needed.

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