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Original Article

Early Postoperative Dehydration and Electrolyte Imbalances Following Ileostomy Creation

Shahram Manoochehry [1,2], Mohammad Sadegh Fazeli [1,3], Amir Keshvari [1,3], Mohammad Reza Keramati [1,3], Alireza Kazemeini [1,3]

[1] Division of Colorectal Surgery, Department of Surgery, Tehran University of Medical Sciences, Tehran, Iran.
[2] Trauma Research Center, Clinical Sciences Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran.
[3] Colorectal Research Center, Tehran University of Medical Sciences, Tehran, Iran.

***Corresponding Author:** Mohammad Sadegh Fazeli, Division of Colorectal Surgery, Department of Surgery, Tehran University of Medical Sciences, Tehran, Iran; Email: mhfazeli@sina.tums.ac.ir.

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Abstract

Introduction: Ileostomy creation is a relatively standard procedure in colorectal surgeries. This study aimed to evaluate the prevalence and severity of dehydration and electrolyte imbalances and find their relationship with patients' demographic and predisposing factors.

Methods: From April 2018 to February 2020, 256 patients who underwent ileostomy creation surgery in the colorectal ward of Imam Khomeini University Hospital (a tertiary center), Tehran, Iran, were enrolled in this study. All patients underwent standard postoperative care and colorectal nursing care. After the ileostomy started to work, patients were evaluated for daily stoma discharge volume and the serum levels of sodium (Na), potassium(K), Magnesium (Mg), Calcium (Ca), Blood urine Nitrogen(BUN), and Creatinine.

Results: Of 256 enrolled patients, three died during the first post-operation period. About 88% of ileostomy started working on the first and the second postop days. There were 64(25.2%) patients with HOI during the index admission and 7(2.7%) patients with prolonged hospital stays (> five days P.O.) only because of HOI. The dehydration rate was highest on the 4th P.O. day, then on the 5th P.O. day, followed by the third day. Altogether there were 108(28.1%) hyponatremia cases in the index admission, with the highest rate on the 4th P.O. day. Altogether, 99 (25.8%) hypokalemia were in the index admission. The least mean serum K level was determined on the fourth day and then on the fifth day. Total and ionized serum Ca levels were lowest on the fifth and fourth days, but the difference between mean Ca levels were insignificant. Mean serum Mg was lowest on the fifth day, followed by the fourth day.

Conclusion: The most prevalent electrolyte imbalance in early PO-readmitted patients was hyponatremia, followed by hypokalemia. Hyperkalemia, hypernatremia, and hypermagnesemia were solely found in readmitted patients and not in the index admission. Early PO readmission with HOI and dehydration was independently associated with Age>60y, Male sex, BMI>30, and living alone status.

Keywords: Dehydration; Electrolyte; imbalances; Ileostomy.

Introduction

Ileostomy creation is a relatively standard procedure in colorectal surgeries. It is mainly performed to reduce postoperative leakage complications after insecure colorectal anastomosis. Ileostomy complications are reported from 6 to 59%, and the most prevalent complication is dehydration. The wide range of ileostomy complication rates may be due to a need for more consensus about the detailed definition of ileostomy complications. Complications are either early (within 30 days postoperative) or late (after the first postoperative month) [1]. Early ileostomy complications are mostly parastomal skin irritation, dehydration, electrolyte impairment, bleeding, necrosis, retraction, and mucocutaneous separation. Late complications may be stenosis, parastomal hernia, ostomy prolapse, etc [2].

A newly created ileostomy begins to discharge within the first 24 to 48 hours, it's daily output usually varies from 500 to 2000ml. An ileostomy is considered high output if its effluent is higher than 1000cc/24hour, and it may result in fluid and electrolyte depletion [3]. Ileostomy formation is accompanied by high early postoperative dehydration, electrolyte imbalances, and even acute renal failure and death. Dehydration is the

reason for 40% of postsurgical readmissions. It is a significant morbidity after ileostomy creation [4,5]. reported electrolyte abnormalities following ileostomy formation are hyponatremia, hypokalemia, hypomagnesemia, and hypocalcemia, usually occurring on the 3rd to eighth postoperative day [6].

More detailed data on electrolyte imbalances and associated risk factors following ileostomy formation must be evaluated. A recent systematic review and meta-analysis found only ten studies evaluating dehydration and readmission after ileostomy formation[7]. regarding electrolyte disturbances, we found only a few studies evaluating serum electrolyte changes following ileostomy making. Then we decided to design this study to evaluate the prevalence and severity of dehydration and electrolyte imbalances and find their relationship with patients' demographic and predisposing factors.

Methods

From April 2018 to February 2020, 256 patients who underwent ileostomy creation surgery in the colorectal ward of Imam Khomeini University Hospital (a tertiary center), Tehran, Iran, were enrolled in this study. The ethics committee of our University confirmed this study. The exclusion criteria were age below 18 years and patients affiliated with chronic renal failure (CRF) or end-stage renal disease (ESRD). All patients underwent standard postoperative care and colorectal nursing care. Patients were discharged when they tolerated soft diet, the stoma discharge volume was below 1000 cc/24h, and they had no electrolyte imbalances.

Before discharge, patients were informed about the danger of dehydration and salt depletion. All of them were educated about drinking high volumes of vegetable and fruit juices and liquids and enough salt to prevent dehydration and electrolyte imbalances. They were also teached to measure the daily volume of ileostomy discharge.

After the ileostomy started to work, patients were evaluated for daily stoma discharge volume and the serum levels of sodium (Na), potassium(K), Magnesium (Mg), Calcium (Ca), Blood urine Nitrogen(BUN), and Creatinine.

Ileostomy output was accounted for high if it was over 1000 cc/24 hours. For high output ileostomy (HOI)patients, the presence and level of dehydration were evaluated twice daily according to objective clinical criteria for dehydration based on the presence of thirst, oliguria, dry mucosa, sunken eyes, reduced skin turgor, postural hypotension, tachycardia and when the clinical dehydration was suspected it was confirmed with serum BUN and creatinine rise [8,9]. Suppose dehydration or any of the electrolyte imbalances were corrected parentally or orally. For all HOI patients, we prescribed loperamide 2mg tablets three times daily per os for at least one month, and if needed, we increased the dose of loperamide up to 16 mg/day to control the HOI. The first post-operation visit was performed 7-10 days after discharge from the hospital. During that visit, patients were evaluated for the volume of stoma discharge, dehydration situation serum levels of Na, K, Mg, Ca, BUN, and Creat and recorded in the checklist.

Electrolyte imbalances were defined as; Hypokalemia<3.4mmole/lit, Hyperkalemia>5 m mole/lit, hypernatremia<133 m mole/lit, hypernatremia>150 m mole/lit, hypomagnesaemia>2.6 m mole/lit, hypomagnesaemia <1.46 m mole/lit, hyperkalemia (total)>10.4 m mole/lit, (ionized)>5.4 m mole/lit, hypocalcaemia (total) <8.8 m mole/lit, (ionized) <4.7 m mole/lit [10].

Data collection

Demographic and patient health factors meticulously recorded in the checklist were age, sex, marital state, educational level, living alone or not, BMI, smoking status, house distance from the hospital, Charleston comorbidity index, and diuretics used on admission.

Recorded operation factors were elective or nonelective (urgent or emergent), surgery indication, and operation approach.

After the ileostomy started to work, we recorded daily stoma discharge volume and the serum levels of sodium (Na), potassium (K), Magnesium (Mg), Calcium (Ca), Blood urine Nitrogen (BUN), and Creatinine.

Recorded data after discharge were daily discharge of ileostomy (performed by the patient at home), dehydration and severity of it, and serum levels of Na, k, Mg, Ca, BUN, and creatinine (evaluated during the first post-operation visit). These post-discharge data were collected in the first post-operation visit or any patient s' visit to the emergency ward or readmission for any reason within the first post-discharge 30 days.

We also recorded the number of early PO readmissions (readmissions during 30 days PO) and the number of early PO readmissions merely because of HOI and dehydration. The readmission criteria were at least 24

hours of stay in the hospital.

Data were analyzed by SPSS-26 software. T-test, Mann-Whitney test, and Chi-2 test were used. A P-value less than 0.05 is considered statistical significance.

Results

Of 256 enrolled patients, three died during the first post-operation period, one due to Ischemic Heart Disease (IHD), one due to pulmonary emboli, and one because of CMV infection. Patients' demographics and health factors are illustrated in Table 1.

Table 1: Patients' demographics and health factors.

Parameter	**N/ Min/ %**
Age	54.96±13.66
60≤	158
>60	95
Sex	
Men	155
women	98
Marital state	
married	208
Single,widow or divorced	45
Living status	
alone	16
With family	237
Smoking state	
never	199
smoker	40
Previous smoker	14
BMI	
<30	211
≥30	42
Distance from hospital	
<100km	176
100-300km	56
>300km	21
Charlson Comorbidity Index	
0	163
1-2	61
≥3	29
Surgery indication	
cancer	227
IBD	19
FAP	7
On diuretics	16
Elective	247
Non elective	6

In 86(33.9%) patients, ileostomies began discharging on the first P.O. day. 139(54.9%) ileostomies started working on the second P.O. day, and 19 (7.5%) ileostomies started discharge on the third P.O. day 6 (2.3%) of ileostomies began to function on the forth P.O. day. as most of the ileostomies (88.8%) started function till second P.O. day we illustrated dehydration and serum electrolytes concentrations from the second P.O. day.

There were 64(25.2%) patients with HOI during the index admission and 7(2.7%) patients with prolonged hospital stays (> five days P.O.) only because of HOI.

There were 6 cases of dehydration on the 2nd P.O. day, 13 cases on the 3rd P.O. day, 18 cases on the fourth day, and 15 cases on the fifth day. Three cases of dehydration were found in the patients who stayed longer than five days P.O. in the hospital. Altogether there were 55(21.7%) dehydration cases in the index admission. All dehydration during index admission was mild except for 2 cases of moderate dehydration, which these 2 cases occurred on the 4th P.O. day. The rate of dehydration was highest on the 4th P.O. day, which was significantly different from the 2nd and third day (Pv<0.05); however not significantly different from the fifth day (Pv=0.23). After 4th day, dehydration was highest on the 5th PO day followed by the 3rd day which both were significantly different from the 2nd day (Pv=0.03 and Pv=0.04).

Table 2: Dehydration and serum electrolytes concentration (m mole/lit) of patients during index admission (mean±2 SD).

electrolyte\day	2nd	3rd	4th	5th
Serum Sodium	137.8±2.3	137.5±2.6	135.5±2.5	135.3±2.3
Serum Potassium	3.9±0.36	3.9±0.29	3.6±0.34	3.7±0.21
Serum Calcium(Total)	9.4±0.41	9.4±039	9.3±037	9.2±038
Serum Calcium(Ionized)	5±0.19	4.9±0.17	4.8±0.18	4.8±0.19
Serum Magnesium	1.92±0.24	1.83±0.25	1.76±021	1.65±0.28
Dehydrated Patients(N)	6	13	18	15

We had a mean serum Na level decline from the 2nd to the fifth day. The decline was significant on the 4th and fifth days compared with the second and third days (P v<0.05). We had nine hyponatremias on the third day, 53 on the fourth day, and 46 on the fifth day. Altogether there were 108(28.1%) hyponatremia cases in the index admission.

The least mean serum K level was determined on the fourth day and then on the fifth day. The difference between the mean levels of the fourth and fifth days was significant compared to the second and third days. There were 13 cases of hypokalemia on the third day, 46 cases on the fourth day, and 40 cases on the fifth day. Altogether, 99 (25.8%) hypokalemia were in the index admission.

Total serum Ca level was lowest on the fifth and fourth days, but the difference between mean total Ca levels was insignificant (Pv =0.15).

The Mean Ionized ca level was lowest on the fourth and fifth days, but the difference was insignificant (Pv=0.08). There were 2 cases of ionized hypocalcemia on the fourth day and two on the fifth day. Altogether there were 4 (1%) of serum ionized hypocalcemia in the index admission except one in hypomagnesemia cases.

Mean serum Mg was lowest on the fifth day, followed by the fourth day. There were 3 cases of hypomagnesemia on the fourth day and 4 cases on the fifth day. There were 7(1.8%)of hypomagnesemia in the index admission.

All cases of hypocalcemia and hypomagnesemia were in patients with HOI. There were 83(76.8%) hyponatremia cases in the HOI patients and 79(66.3%) hypokalemia cases in HOI patients.

In the first P.O visit, there were 12 cases of HOI and 6

cases of dehydration (4mild, two moderate), 4 cases of hyponatremia, 7 cases of hypokalemia, one case of hypomagnesemia and no cases of hypocalcemia.

The number of all causes of early PO readmissions was 54 (21.3%). There were 27 (10.6%) readmission with HOI and dehydration that 22(8.6%) cases of early PO readmission merely because of HOI and the resulting dehydration. Of these 22, 7 cases of pre-renal renal failure occurred, and 2 of these seven patients died. This merely dehydration readmitted patients all had moderate to severe dehydration (13moderate, nine severe). There was hyponatremia in 13 cases, hypernatremia in eight cases, hypokalemia in 12 cases, and hyperkalemia in 10 patients. We had 3 cases of hypocalcemia (total and ionized), and 4cases of hypomagnesemia, and 5 cases of hypermagnesemia.

The relation of patients' factors with readmission due to HOI and dehydration is illustrated in Table 3.

Age, Sex, BMI, and living status were associated with early PO readmission due to HIO and dehydration in bivariate analysis. Early PO readmission with HOI and dehydration was independently associated with Age>60y, Male sex, BMI>30, and living alone status in multivariate logistic regression.

Table 3: Patients' factors and readmissions with HOI and Dehydration.

Patients' factors	HOI and dehydration patients	Total numbers
60≤Age	14	158
age>60	13	95
Male	20	155
Female	7	98
married	21	208
Single,widow or divorced	6	45
Living alone	4	16
Living With family	23	238
Never smoker	19	199
smoker	6	40
previous	1	14
BMI <30	17	211
BMI ≥30	10	42
Distance from hospital <100km	19	176
Distance from hospital 100-300km	6	56
Distance from hospital >300km	2	21
Charlson Comorbidity Index 0	17	163
Charlson Comorbidity Index 1-2	7	61
Charlson Comorbidity Index ≥3	3	29
Cancer patients	21	227
IBD patients	4	19
FAP patients	2	7
On diuretics	2	16

Discussion

In this study, ileostomies started functioning 0n PO day 1st to fourth, similar to other studies. [1,3, 5] Most of the ileostomies began to discharge on the 2nd PO day (55%), followed by the 1st (34.4%).

There were 64(25.2%) patients with HOI during the index admission and 7(2.7%) patients with prolonged hospital stays (> five days PO) only because of HOI. There were3 patients whose HOI was not controlled even with six loperamide 2mg tablets per day, and we added diphenoxylate tablets to reduce ileostomy output 2. Of these patients were IBD and 1 FAP patients. The higher prevalence of resistant HOI in patients who underwent total procto- colectomy ileal pouch-anal anastomosis may be due to the shorter length of the bowel proximal to the ileostomy site.

In the current study, the rate of HOI was 25%, similar to other studies that reported HOI from 13.6% up to 26%. The reason for placing the HOI rate of our study near the upper limit may be because we accounted for ileostomy output>1lit/24h as a high output. However, the criteria in different studies differed from > 1it/24h and>1.5lit/24h to >2lit/24h [11].

In our study, only 2.8% prolonged hospital stay was prolonged because of HOI. We could find no other study that has evaluated and reported this before.

In the current study, dehydration during index admission was highest on the 4th PO day, followed by the 5th and 3rd PO days, similar to a few other studies that evaluated it [5,7,12]. then we should closely monitor ileostomy patients for dehydration from the 3rd to 5th PO day for its timely treatment.

There were 28.1% of serum hyponatremia and 25.8% of serum hypokalemia in the index admission. Hyponatremia was the most prevalent electrolyte imbalance, followed by hypokalemia in this study, although other studies have reported hyponatremia and hypokalemia in ileostomy patients; however, we found no study that reports the prevalence in the index admission [2,6,11].

There was no total hypocalcemia; however, 1.5% of ionized hypocalcemia was primarily secondary to hypomagnesemia in the index admission. In a study that evaluated calcium metabolism in permanent ileostomy patients, serum calcium level was in the normal range. The difference between our study and the mentioned study may be because our patients had newly created ileostomies and were in the early PO period; however, the cases of the mentioned study were not in the early PO period and had been adapted to ileostomies [14].

Hypomagnesemia was 1.5% in the index admission in our study; all cases of hypomagnesemia and hypocalcemia in the index admission were in HOI patients. There were no other studies to report the hypomagnesemia rate except for a few case reports [15].

In this study, early PO readmission with HOI and dehydration was independently associated with Age>60y, Male sex, BMI>30, and living alone status. These results were similar to other studies.

Age and sex, however, BMI, were not associated with higher readmission in other studies. We found no study evaluating the role of lonely living status in readmissions due to HIO and dehydration [3,12].

In this study, 21.1% of readmission, HOI, and dehydration accompanied 9.3%, and 7.3% of readmissions were sole because of HOI and dehydration. The rate of readmissions was similar to other studies [3,4,5,12].

The most prevalent electrolyte imbalance in early PO-readmitted patients was hyponatremia, followed by hypokalemia. Hyperkalemia, hypernatremia, and hyper-magnesemia were solely found in readmitted patients and not in the index admission .it was probably due to severe dehydration and renal impairment in some readmitted patients. This may be due to renal impairment in early PO-readmitted patients, leading to these electrolyte imbalances.

We hypothesized that the long distance of patients' homes from the hospital and lonely living-alone status might cause more readmissions and more critical situations during readmissions (due to less care in lonely status and demanding access to the hospital at a long distance). However, the lonely living status was associated with more readmissions and more critical situations during readmissions. The distance of the patients' homes was not an efficient factor in more and more critical readmissions.

Conclusion

The most prevalent electrolyte imbalance in early PO-readmitted patients was hyponatremia, followed by hypokalemia. Hyperkalemia, hypernatremia, and hypermagnesemia were solely found in readmitted patients and not in the index admission. Early PO

readmission with HOI and dehydration was independently associated with Age>60y, Male sex, BMI>30, and living alone status.

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None.

Conflict of Interest Disclosures

We declare that there is not conflict of interest in this study.

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None.

Authors' Contributions

All authors contributed equally to accomplishing this study.

Ethical Statement

Division of Colorectal Surgery, Department of Surgery, Tehran University of Medical Sciences Confirmed protocol of this study.

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