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Evaluation of Changes in Serum Sodium and Potassium Following Ileostomy and Colostomy

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ABSTRACT: *Maintenance of normal fluid-electrolyte balance is desirable for maintenance of homeostasis. Much is now known about the metabolism of sodium and potassium and their effects on the body when these electrolytes are deficient. Their loss through skin, kidney and bowel has been studied. But less is known about their excretion through artificially created stoma of the bowel. Further not much work was done in this respect in this rural part of the West Bengal with extreme climate and great swing in temperature dryness. This compounds the problem of such patients due to increase losses of fluid and electrolytes through the skin and lungs. In our study we estimated serum electrolytes, namely serum sodium and serum potassium post operatively at 24hrs (1st post operative day), 72 hrs (3rd post operative day) and 120 hrs (5th post operative day) during the post operative study period, no patient expired and all the patients resuscitated adequately in pre operative period, and maintained an adequate urine output. All the patients in this study had their stoma created on operation for emergency condition. We concluded that patients having high output ileostomy (≥1000ml/day), there was a significant decrease in serum sodium and serum potassium on 5th post operative day. And we recommend that all patients who undergo ileal resection along with ileostomy, or who have high ileostomy output, should be closely monitored for electrolyte derangement from the 3rd post operative day onwards.*

Key words: *Ostomies, Ileostomy dejecta,*

I. INTRODUCTION

Maintenance of normal fluid-electrolyte balance is desirable for maintenance of homeostasis. Electrolyte imbalance may be intra or extra cellular among which serum electrolytes are readily measured. For all practical purposes, measurement of serum electrolyte along with finding of clinical status and other relevant status (ECG, acid base status etc) are used for clinical management of patient. Usually an excess loss of fluid and/ or electrolytes occurs through gastrointestinal tract, respiration, skin, kidney and other abnormal process of elimination like vomiting, fistulas, third space sequestration (where they are not at free equilibrium with rest of the extracellular body fluid) and surgically created ostomies like ileostomy and colostomy. The character and amount (along with its water content) and electrolyte content of the ostomies effluent also vary along with the site of ostomies, duration after ostomies creation, and amount and content of oral intake. These ostomies effluent is very significant with loop ileostomy with partial resection of ileum, ileostomy and least with colostomy. Disease processes like Crohn's disease and ulcerative colitis etc, also influence the amount of effluent. When the amount of stoma effluent is around 500 ml or less, it is low volume stoma. When the volume of stoma effluent is 1 litre, it is a high volume stoma (Hills GL et al, 1975)[1]. Patients with high output stoma are prone to salt and water depletion, especially when there is associated resection of significant length of ileum (Hills et al, 1975)[2]. Not much work was done in this respect in this rural part of the West Bengal with extreme climate and great swing in temperature dryness. This compounds the problem of such patients due to increase losses of fluid and electrolytes through the skin and lungs. In our study we estimated serum sodium (Na+), potassium (K+) and evaluated hydration from input output chart and clinical findings.

II. AIMS AND OBJECTIVES

A) To evaluate the amount of different ostomies (ileostomy, colostomy, ileal resection with ileostomy) effluent.
B) To find out serum electrolyte changes in the body associated with different amount of ostomies output, while fluid and electrolyte management went on in the form of intravenous fluid administration, oral intake or feeding jejunostomy/ ileostomy feeding and blood transfusion (if needed) in an attempt to keep the patient normovolaemic as far as practicable, and to relate the changes and serum electrolyte level to the outcome of the treatment given.
C) To utilise the above fact in making a fluid and electrolyte management protocol for such ostomies patients to reduce the morbidity and mortality.

III. MATERIALS AND METHODS

It is a prospective observational study of fluid and electrolyte changes in ileostomy /colostomy cases-

A. Study area: Department of General Surgery of Bankura Sammilani Medical College and Hospital, Bankura, West Bengal, India.
B. Study population-Patients from various parts of Bankura adjoining districts, who are admitted in surgical ward of BSMCH and operated on, in which ileostomy and colostomy is done with or without partial resection of ileum.
C. Study period- January 2012- July 2013.
D. Sample size- 50 consecutive patients following inclusion and exclusion criteria
E. Sample design-Patients who are admitted to the BSMCH and undergone ileostomy and colostomy and follow up with intravenous fluid and electrolyte with other necessary treatment-
    a. Inclusion criteria-
        i. No sex bar.
        ii. No age bar.
        iii. Patient who undergone ileostomy/colostomy or ileostomy with or without ileal resection and postoperatively treated with intravenous fluid and electrolyte at least up to 3rd postoperative day along with gradual resumption of oral intake or feeding jejunostomy/ ileostomy feeding and managed at least for 5 days.
    b. Exclusion criteria-
        i. ASA Grade 3, NYHA Grade 3 or above.
        ii. Known co-morbidities as example renal or respiratory failure.
        iii. End stage liver disease
        iv. Patient who do not survive within respective study period(5 days)
        v. Patient who refused to consent or withdrawn from the study or DORB/ Transfer to other place
        vi. Patient with uncontrolled metabolic disease
F. Study design- Prospective randomized observational study.
G. Study technique- 50 patients of various parts of Bankura and adjoining districts admitted in the Surgery department of BSMCH and subsequently undergone ileostomy/ colostomy during the study period of 1½ year and managed postoperatively by intravenous fluid and electrolytes for at least to the 3rd postoperative day and oral intake as or when tolerated with feeding jejunostomy/ ileostomy were included in this study randomly after taking proper consent and counseling and evaluated clinically by amount of stoma output, urine output, routine and special investigation (serum electrolytes: sodium, potassium) in Biochemistry department of BSMCH by instruments and following measuring techniques- sodium and potassium were measured by ion selective electrode and validated by flame photometry.

On 1st, 3rd and 5th postoperative days, serum electrolyte changes were calculated in different types of ostomies these data are statistically evaluated and management protocol is proposes to reduce their morbidity and mortality.

III. REVIEW OF LITERATURE

Creation of ileostomy/colostomy is done to save the patient's life. Indication of ileostomy/colostomy are-a) Perforative peritonitis (61%) – due to enteric , tubercular or other causes. b) Intestinal obstruction (28.6%), c) Malignancy (10%)

According to the study in the Department of General Surgery, Jawaharlal Nehru Medical College Aligarh, Muslim University- where the mean age of patient was 33.14 yr range (13 to 80 yrs). In another study cases leading to performance of ileostomy where crohn's disease (mean age of presentation 41 yrs) and ulcerative colitis (mean age of presentation 38 yrs)[3]. In yet other study ostomies were performed for cancer (33%), inflammatory bowel disease (21.9%), diverticulitis (14.9%), and perforative peritonitis (2.3%) in which most of the patients was elderly (above 70yrs)

The character and the output of the ostomies effluent depend on the site of gastrointestinal tract where the ostomies are done. It is a high output with bile and enzyme rich effluent in case of jejunostomy, ileostomy with resection of ileum, ileostomy, and of much less output with semisolid or solid contents in case of colostomy.

When the amount of stoma effluent is around or less than 500 ml, it is low volume stoma, and when the volume of stoma output is 1 lit or more, it is high volume stoma. Patients with stoma output less than 1 lit daily are seldom troubled. On the other hand, patients with high output stoma are prone to salt and water depletion,

especially when there is associated partial resection of ileum, resulting in unusually profuse ileostomy output. (Hills et al, 1975)[2].

Some of the observation and conclusion by A.O. Wilson, Department of Surgery, Postgraduate medical school of London, is as follows: a) In the immediate post operative period of terminal ileostomy, it may be difficult to maintain a satisfactory state of hydration. b) Sodium deficiency is very liable to develop, because the sodium content of ileostomy fluid is greater than that of chloride. c) Treatment by sodium citrate by mouth should be begun as soon as possible after operation. Large amount may be required, together with additional sodium chloride if the ileostomy is very active [4].

Much is now known about the metabolism of sodium and potassium and their effects on the body when these electrolytes are deficient. Their loss through skin, kidney and bowel has been studied. But less is known about their excretion through artificially created stoma of the bowel. The earliest reliable study of small intestinal contents in the human were reported by Abott W E (1963) who obtained specimen of jejunum and ileum contents from fasting human by means of specially devised tube [5].

Fowler DI had suggested that the amount of sodium required for replacement therapy during the first few postoperative days could be calculated by rule of thumb procedure in which, 300meq of sodium chloride was given for each liter of ileostomy fluid loss. They thought that provided potassium deficiency was corrected before operation, potassium supplement were unnecessary after operation, unless enteritis developed [6]. Kanaghinis T, Lubran M, Coghill NF pointed out that sodium concentration in ileostomy dejecta as found by them were much higher than those found by other workers [7]. Subsequently they suggested that their high sodium concentration figures were due to oral administration on enteric coated salt tablet which might have escaped complete digestion.

Administration of potassium chloride, which is efficiently absorbed but regard must be paid to the increase in water and sodium loss in ileostomy dejecta during potassium chloride administration. Resolution with sodium by orally administered sodium chloride may be much more difficult to achieve because of increased loss of sodium in ileostomy effluent. Rehydration with oral fluid may also be difficult because of water loss induced by the load. Absorption of water and sodium in case of water and sodium depletion in ileostomy patients may be impaired by concurrent administration of codeine or opium.

Information is not readily available about the management of fluid and electrolyte exchange in patients with recent ileostomy. Our experience shows that sodium administration is essential on occasion in after treatment of patients with ileostomy.

The maximum volume of fluid lost from the ileostomy observed during any one 24 hours period was 3500ml, less than daily loss of 4 litres , or more which was observed by Carmicheal D et al, when abnormal losses occur at this rate, particular attention is required for their precise replacement. Failure to do so jeopardizes the chance of recovery. Fortunately, not all ileostomy patients loss fluid in this way in early postoperative period.[8]

Adaptation of ileostomy usually develops after a period of several weeks of operation.With decrease in the volume of fluid lost and in the concentration of sodium, potassium in it (Lockwood and Randall , 1949)[9].

IV. RESULTS

The estimation of serum electrolytes, namely serum sodium and serum potassium were done post operatively at 24hrs (1st post operative day), 72 hrs (3rd post operative day) and 120 hrs (5th post operative day) during the post operative study period, no patient expired and all the patients resuscitated adequately in pre operative period, and maintained an adequate urine output. All the patients in this study had their stoma created on operation for emergency condition.

Table 1: Case distribution according to age and sex

AGE(YRS)	MALE (%)	FEMALE (%)	TOTAL (%)
<25	2(6.67%)	2(10%)	4(8%)
25-49	22(73.33%)	12(60%)	34(68%)
50-74	4(13.33%)	4(20%)	8(16%)
75 OR MORE	2(6.67%)	2(10%)	4(8%)
TOTAL	30	20	50

Table 1 reveals that the maximum number of patients were in the 25-49 yrs age group, i.e., 34 (including 22 male and 12 female) and the youngest patient was 18yrs old and the oldest one being 76yrs old. The mean age of the patients was 43.36 yrs (male: 40.8yrs; female: 47.2yrs).

Table 2: Case distribution according to the diagnosis

DIAGNOSIS	NO.OF CASES	PERCENTAGE
(1)PERFORATIVE PERITONITIS(ENTERIC/T.B/OTHER)	24	48
(2)INTESTINAL OBSTRUCTION	10	20
(3)INTESTINAL OBSTRUCTION WITH PERITONITIS	10	20
(4)PENITRATING INJURY ABDOMEN WITH BOWEL INJURY	4	8
(5)SEPTIC ABORTION WITH BOWEL INJURY	2	4
TOTAL	50	100

From Table 2, the majority of the patients who underwent stoma creation were of perforative peritonitis 24(48%) patients following typhoid, tubercular or non –specific enteritis. 10 patients (20%) presented with intestinal obstruction, out of these, 4 cases had malignancy. 10 cases in addition to obstruction had associated peritonitis (8 cases of sigmoid volvulus and 2 cases of adhesion obstruction). The remaining 6 cases had stoma creation due to penetrating injury abdomen (4), and only 2 cases with septic abortion with bowel injury.

Table 4: POST OPERATIVE STOMA OUTPUT (in ml)

Post operative day	All stoma patients	All ileostomy patients	Ileostomy + no resection of small intestine	Ileostomy + resection of small intestine	Stoma + no resection of small intestine	Colostomy patients
3rd day	444.9 ±251.5 (N= 50)	490 ±137.6 (N=42)	476 ±191 (N=30)	525 ±126 (N=12)	419.6 ±257.2 (N=38)	208 ±90 (N=8)
5th day	654.5 ±449.1 (N= 50)	717.2 ±371.3 (N=42)	671±161 (N=30)	833±195 (N=12)	598.2 ±424.8 (N=38)	300±95 (N=8)

'N' *signifies the number of patients; Stoma output is taken in mean± 2SD*

From Table 4, the average daily quantity of stoma output in all patients on 3rd post operative day was 444.9ml and on 5th post operative day the amount was 654.5ml. Stoma output on 1st post operative day was not taken into consideration as most of the stomas were not functioning at that time. The average daily stoma output in patients having stoma with no resection of small bowel was 476ml and 671ml on the 3rd and 5th post operative days respectively and that in patients having Ileostomy with resection of small bowel was 525ml and 833ml on the 3rd and 5th post operative days respectively. The average daily stoma output in all patients having Ileostomy was 490ml on 3rd post operative day and 717.2ml on 5th post operative day. Quantity of stoma output between Ileostomy and colostomy patients showed a highly significant lower amount in colostomy patients on both the 3rd and 5th post operative days ($p < 0.001$). Patients who underwent additional intestinal resection had a significantly higher stoma output. Stoma output of patients without any resection of small intestine shows a significant lower amount on the 3rd post operative day ($p<0.05$) and a highly significant lower amount on the 5th post operative day ($p< 0.001$).

Table 5: Distribution according to the stoma output and procedure done

OPERATIVE PROCEDURE	DAY 3			DAY 5		
	< 500 ml	500- <1000ml	≥1000ml	< 500ml	500- <1000 ml	≥1000ml
All stoma patients	28 (56%) N=50	22(44%) N=50	0 N=50	12 (24%) N=50	36 (64%) N=50	6 (12%) N=50

All ileostomy patients	20 (47.62%) N=42	22 (52.38%) N=42	0 N=42	4 (9.53%) N=42	32 (76.19%) N=42	6 (14.28%) N=42
Ileostomy + no resection of small bowel	16 (53.33%) N=30	14 (46.67%) N=30	0 N=30	4 (13.33%) N=30	24 (80%) N=30	2 (6.67%) N=30
Ileostomy + resection of small bowel	4 (33.33%) N=12	8 (66.67%) N=12	0 N=12	0 N=12	8 (66.67%) N=12	4 (33.33%) N=12
Stoma with no resection of small bowel	26 (68.42%) N=38	12 (31.58%) N=38	0 N=38	12 (31.58%) N=38	24 (63.16%) N=38	2 (5.26%) N=38
Colostomy	8 (100%) N=8	0 N=8	0 N=8	8 (100%) N=8	0 N=8	0 N=8

'N' *signifies the number of patients*

On 3rd post operative day, out of 30 patients of ileostomy with no resection of small bowel 16 (53.33%) patients had stoma output of <500ml and rest of 14 (46.67%) patients had stoma output between 500- <1000ml, with a mean of 476± 191 ml and on 5th post operative day, out of 30 patients 4 (13.33%) patients had stoma output <500 ml, 24 (80%) patients' output between 500 - <1000 ml and 2 (6.67%) patient >1000 ml, with a mean output of 671 ± 161 ml. (table 4 & 5).

In 12 patients having ileostomy with resection of small bowel, 4 (33.33%) patients had stoma output of <500ml and 8 (66.67%) had stoma output between 500- <1000 ml on the 3rd post operative day, with a mean of 525±126 ml. On 5th post operative day, out of 12 patients of ileostomy with resection of small bowel, 8 (66.67%) had stoma output between 500- <1000ml and 4 (33.33%) patients had stoma output of ≥1000ml, with a mean of 833±195 ml. (table 4 & 5).

In 38 patients of stoma with no resection, 26(68.42%) had stoma output of <500ml and the rest 12 (31.58%) patients had stoma output of 500- <1000ml on 3rd post operative day. On the 5th post operative day, of the 38 patients, 12(31.58%) patients had stoma output of <500ml, 24 (63.16%) patients had stoma output between 500- <1000ml and 2 (5.26%) had stoma output of >1000ml. (table no. 4 & 5).

In a total 8 patients of colostomy, the stoma output was <500ml on both 3rd and 5th post operative day, with a mean of 208±90ml on 3rd post operative day and 300±95 ml on 5th post operative day.(Table no.4 & 5).

- No patients expired on 1st, 3rd and 5th post operative day

Group 1: all stoma patients containing all ileostomy and colostomy patients (N=50)
Group 2: all ileostomy patients (N=42)
Group 3: ileostomy patients who underwent additional resection of small bowel (N=12)
Group 4: stoma (ileostomy + colostomy) patients having no resection of small bowel (N=38)
Group 5: all colostomy patients (N= 8)
Group 6: patients having stoma output >1000ml on 5th post operative day (N=6)

Table 6: Comparison of serum sodium (mmole/lit), in various groups of stoma patients (mean ±2 sd)

Patient groups	1st post operative day (a)	3rd post operative day (b)	5th post operative day (c)
All stoma patients	138±2.5	137.23±2.7	136.2±2.5
All ileostomy patients	137.8±2.5	136.6±2.3	135.4±1.7
Ileostomy with resection of small bowel	137.6±2.5	135.9±1.5	134.3±1.1
Ileostomy + no resection of small bowel	138.2±4.4	137.6±2.8	136.7±2.5
Colostomy	139.3±3.8	140±2.6	139.6±1.8
Stoma output ≥ 1000ml on 5th post operative day	137.1±2.5	135±1.7	133.6±1

1) In the group all stoma patients having post operative reading was compared to day 1 operative and 5 when post operative day 3 readings, a significant lower reading was observed on day 3 ($p< 0.05$) and day 5 ($p< 0.001$). When post operative day 3 reading was compared with post operative day 5 reading, a significant lower reading was observed on post operative day 5 ($p < 0.01$). [A:B=S, A:C=S, B:C=S, (S=significant, NS= not significant)]

2) In the group having all ileostomy patients, when post operative day 1 reading was compared to post operative day 3 and 5 readings, a significant lower reading was observed on post operative day 3($p< 0.05$) and day 5($p< 0.001$). When post operative day 3 reading was compared to post operative day 5 reading, a significant lower reading was observed on post operative day 5($p<0.01$). [A:B=S, A:C=S, B:C=S]
3) In the group having ileostomy with resection of small bowel, when post operative day 1 reading was compared to post operative day 3 and 5 readings, a significant lower value was observed on post operative day 3($p< 0.05$) and day 5($p<0.001$). When post operative day 3 reading was compared to post operative day 5 reading, a significant lower value was observed on day 5($p<0.01$). [A:B=S, A:C=S, B:C=S]
4) In the group having stoma with no resection of small intestine, no statistically significant change ($p>0.05$) was observed with post operative day 1 and day 3 readings when compared. However, a statistically significant lower reading was observed on post operative day 5 ($p<0.05$). Changes in the serum sodium level between post operative day 3 and 5, were statistically significant [A:B=NS, A:C=S, B:C=S]
5) In group having colostomy, no significant change ($p>0.05$) was observed when post operative day 1, day 3, and day 5 readings were compared to each other. [A:B=NS, A:C=NS. B:C=NS]
6) In the group having daily stoma output >1000ml (on 5th post operative day), no significant change ($p>0.05$) was noted when post operative day 1 reading was compared to post operative day 3 reading. A statistically significant lower value was observed on post operative day 5 when post operative day 1 and 3 readings were compared to post operative day 5 reading($p<0.05$). [A:B=NS, A:C=S, B:C=S]

In comparison of group (2), ileostomy and group (5) colostomy patients, no significant change ($p>0.05$) was observed when post operative day 1 readings were compared. When post operative day 3 and day 5 readings were compared between group (2) and (5), the readings in the ileostomy group were found to be significantly lower than that in the colostomy group ($p<0.001$). [A:A=NS,B:B=S, C:C=S]

In comparison of group (3) ileostomy with resection of small intestine and group (4) stoma with no resection of small intestine, no significant change ($p>0.05$) was obtained when post operative day readings were compared. When post operative day 3 and day 5 readings were compared between these groups (3 and 4), the reading in group (3) ileostomy with resection of small intestine, were found to be significantly lower than that in group (4) ($p<0.05$). [A:A=NS, B:B=S, C:C=S]

Except for the patients of group (3) ileostomy with resection of ileal segment and group (6) stoma patients with output >1000ml/day who, on the 5th post operative day, had a mean sodium level below 135 mmol/l, all other groups of stoma had mean serum sodium levels in normal range in the post operative period.

The value serum sodium ranges 134-143 mmol/l on post operative day 1, 132-145 mmol/l on post operative day 3 and 132-144 mmol/l on post operative day 5.

10 out of 50 patients on post operative day 10 had serum sodium value of <135mmol/l. The rest of the patients had a value in the normal range of 135- 145 mmol/l.

Table7: Comparison of serum potassium (mmol/lit) in various groups of intestinal stoma patients (mean±2sd).

Patients groups	Day1(a)	Day3(b)	Day5(c)
All stoma patients	3.9±0.1	3.79±0.32	3.75±0.32
All ileostomy patients	3.9±0.33	3.8±0.33	3.7±0.33
Ileostomy +resection of small bowel	3.9±0.19	3.7±0.19	3.7±0.3
Stoma + no resection of small bowel	3.9±0.12	3.8±0.34	3.7±0.3
Colostomy	3.9±0.3	3.8±0.23	3.8±0.22
Stoma output ≥ 1000ml on 5^{th} day	4±0.3	3.7±0.6	3.6±0.2

1) In the group having all stoma patients, when postoperative day 1 reading was compared to postoperative day 3 and day 5 readings, a significant lower value was observed, on postoperative day 3 ($p<0.05$) and day 5($p<0.001$). When postoperative day 3 reading was compared with postoperative day 5 reading, there was no observable significant change ($p>0.05$). [A: B= S, A: C= S, B: C= NS].
2) In the group having all ileostomy patients, when postoperative day 1 reading was compared with day 5 reading, a significant lower value ($p<0.05$) was observed on postoperative day 5. When postoperative day 3 reading was compared with postoperative day 1 and day 5 reading, no significant change was however observed ($p>0.05$). [A: B= NS, A: C= S, B: C= NS].
3) In the group having ileostomy with resection of small intestine , when post operative day 1 reading was compared to postoperative day 3 and day 5 readings, a significant lower value ($p<0.05$) was observed on postoperative day 3 and day 5. When postoperative day 3 was compared with postoperative day 5 reading, no significant change ($p>0.05$) was observed. [A: B= S, A: C= S, B: C= NS].

4) In the group having stoma with no resection of small intestine, when postoperative day 1 reading was compared to postoperative day 3 and day 5 readings , postoperative day 3 ($P<0.05$) and day 5 ($p<0.001$) readings were found to be significantly lower than day 1. No significant change ($p>0.05$) was observed when postoperative day 3 were compared to postoperative day 5 reading. [A: B= S, A: C= S, B: C= NS].
5) In the group having colostomy, no significant change ($p>0.05$) was observed when postoperative day 1, day 3 and day 5 readings were compared to each other. [A: B= NS, A: C= NS, B: C= NS].
6) In the group having daily stoma output ≥ 1000 ml on the 5th postoperative day, when postoperative day 1 reading was compared to postoperative day 5, postoperative day 5 reading was observed to be significantly lower ($p<0.05$).No significant change ($p>0.05$) was observed when postoperative day 3 reading was compared to postoperative day 1and day 5 readings. [A: B= NS, A: C= S, B: C= NS].

In comparison of group (2) ileostomy and group (5) colostomy, no significant change ($p>0.05$) was observed when postoperative day1, day3 and day5 reading were compared between these groups. [A: A= NS , B: B= NS, C: C= NS].

In comparison of group(3) ileostomy with resection of small intestine and group(4)stoma without resection of small intestine no significant change($p>0.05$) was observed when postoperative day1,day3 and day 5 readings were compared between these groups. [A: A= NS, B: B= NS, C: C= NS].

The mean values of serum potassium remained within the normal range in the postoperative period in all groups. The values of serum potassium ranged from 3.6-4.2mmol/l on postoperative day 1, 3.5-4.1mmol/l on postoperative day 3 and 3.5-4.0mmol/l on postoperative day 5.

V. DISCUSSION

The age of the patients in the study was in the range of 18-76 years, with a mean of43.28 years. Most of the patients in our study (68%) were in 25-49 years age group.

The majority of the patients (48%) underwent stoma creation for perforative peritonitis (enteric, tubercular and other causes) and intestinal obstruction (20%), and intestinal obstruction with peritonitis (20%). There were no cases of Crohns' disease and ulcerative colitis or diverticulitis.

It is in contrast to the study of A.O. Wilson, where most of the patients were of Crohns' disease(mean age 41 years) and ulcerative colitis(mean age 38 years) who were operated for ileostomy[4].

In the study of Abbot, WE, most patients were elderly (above 70 years) and ostomies were created for cancer (33%), IBD (21%), diverticulitis (14.9%) and only 2.3% for perforative peritonitis. In our study, there were only 4 cases (8%) of malignancy and 24 (48%) cases were of the perforative peritonitis, which underwent stoma creation[5].

Quantity of daily stoma output in postoperative period:

In the previous studies the volume of daily ileostomy output was reported in the range of 200-500ml (Fowler DI 1959; Kanaghinis et al,1963; Kaplan SA et al,1962;)[6,7,10]. Low volume ileostomy was defined as daily output around 500 ml and high volume ileostomy as a daily volume of a liter or more, by Hill et al 1975[1].

In our study the average stoma volume in ileostomy patients was 490(±137.6) ml on the 3rd day and 717.2(±371.3) ml on the 5th postoperative day.

The ileostomy output tended to be unusually profuse if additional ileal resection had to be performed (Hill et al 1975)[1]. In our study the ileostomy patients in which resection of ileum was done, the mean output on the 3rd postoperative day was 525(±126)ml and on the 5th day was 833(±195)ml and was significantly higher than patients having stomas with no resection of the ileum($p<0.05$).

New ileostomy may produce a diarrhea of 1-2 lit/day as reported by A.O. Wilson et al[4]. In this study, 6(12%) of ileostomy patients had ≥1000ml/day of stoma output on 5th postoperative day, 4 of these 6 patients had ileostomy with resection. The output from colostomy was significant lower than ileostomy and the metabolic changes were mostly confined to the ileostomy patients. Similar results were reported by Abbot, WE et al (1963)[5].

Serum sodium:

The present study revealed a significant decrease in serum sodium concentration postoperatively in patients who underwent stoma creation. Ileostomy patients had significantly lower serum sodium levels compared to colostomy patients on 3rd and 5th postoperative days ($p<0.001$).

Ileostomy patients having resection of small intestine had significantly lower serum sodium level compared to stoma patients with no resection of small bowel on the 3rd and 5th postoperative days($p<0.05$). No significant difference was found on postoperative day 1.

The mean value of serum sodium on postoperative day 1, day 3 and day 5 remained within normal range in all groups of stoma patients except the group having ileostomy with resection of small intestine, and the group of patients having stoma output ≥1000ml on postoperative day 5, in which mean serum sodium level decreased below normal on 5th postoperative day.

In the group having all stoma patients, there was a decrease in the mean serum sodium level from postoperative day 1, day 3 and day5 were statistically significant($p<0.05$).

In the group having ileostomy with resection of small intestine, there was a decrease in mean serum sodium level from postoperative day1 to day5 reaching below normal range on postoperative day5 (134±1.1 mmol/l). The difference between post operative day 1 and day 3 was significant and the difference between post operative day 5 and post operative day 3 ($p<0.01$) and day 1 was highly significant ($p<0.001$).

In the group having stoma with no resection of small bowel, post operative day 5 values of serum sodium were significantly lower than day 1 values ($p<0.05$), but no significant differences were found between comparison of other post operative values.

In the group having colostomy, no significant difference was found in serum sodium values in post operative period.

In the group having stoma output ≥1000ml/day on post operative day 5, there was a significantly lower value of mean serum sodium on post operative day 5 as compared to post operative day 1 and day 3. The mean serum sodium value was lower than the normal range on the 5th post operative day (133.6±1 mmol/l).

The above finding compared to the works of Hill GL et al, (1974), Gallagher et al, (1962) [2,11] who also observed decrease in serum level in post operative period in patients with ileostomy. Hill et al, 1975,[2] also observed the resection of ileum with ileostomy increases stoma output and electrolyte losses.

Serum potassium:

In our study, no significant change was observed when post operative day 1, day 3, and day 5 serum potassium values were compared between ileostomy and colostomy patients and between patients having ileostomy with resection of ileum and stoma patients with no resection of ileum.

The mean value of serum potassium of post operative day 1, day 3 and day 5 remain within the normal range in all groups of stoma patients.

In all groups of stoma patients, the value of serum potassium decreases slightly from post operative day 1 to day 5, but remain within the normal range.

Significantly lower serum potassium value of post operative day 3 and day 5 were observed, compared to post operative day 1 in the groups of all stoma patients, ileostomy patients with resection of small intestine and ileostomy patients with no resection of small intestine ($p< 0.05$). No significant change was observed between post operative day 3 and day 5 values.

In the groups having all ileostomy patients and patients with stoma output ≥ 1000ml on the 5th post operative day, the post operative day 5 value of serum potassium was found to be significantly lower than the day 1 value ($p< 0.05$). No significant change was found in the post operative period in the colostomy patients.

This is in agreement with the result documented by various authors. Golighar JC, (1975), Elkinton JR et al, (1944), who observed a slight decrease in serum potassium levels in ileostomy patients, but no sign of potassium depletion in patients with ileostomy[1,12].

However, some other authors had observed an increase in serum potassium level in patients with ileostomy N.D Gallagher et al, (1962), No such increase was noted in this study[11].

VI. CONCLUSION

The stoma output was found to be higher in patients having ileostomy and was significantly higher in patients who had additional ileal segment resection done.

Serum potassium level showed a significant decrease in patients with ileostomy, especially those having additional resection of ileal segment in the postoperative period, on the 5th postoperative day.

The patients with colostomy showed no significant changes in serum electrolytes concentration in post operative period.

In group of patients having high output ileostomy (≥1000ml/day), there was a significant decrease in serum sodium and serum potassium on 5th post operative day.

The mean serum sodium level remained within the normal range on post operative day 1, day 3 and day 5 in all groups of stoma patients, except in patients having ileostomy with additional resection of ileal segment and patients with high ileostomy output (≥1000ml/day), in which serum sodium level decreased below the normal range by 5th post operative day.

The serum level of potassium remained within normal range in post operative period in all group of stoma patients.

From the study, it can be concluded that:

(1) Patients undergoing colostomy have low stoma output i.e., below 500ml/day; they do not develop fluid or electrolyte derangement in early post operative period and needed no monitoring.
(2) Patients undergoing ileostomy have average stoma output higher than colostomy patients, i.e., around 500-600ml/day; all these patients showed a fall in electrolyte value in early post operative period, but the mean values tend to remain in normal range.
(3) Patients, who underwent ileal resection in addition to ileostomy, had a significantly higher stoma output. The patients showed a significant fall in serum electrolyte levels, especially sodium, potassium, chloride and bicarbonate. Serum sodium value fell below normal range by the 5th post operative day.

Patients with high output stomas (≥1000ml/day) develop significant derangement of serum electrolytes, namely sodium and potassium.

VII. RECOMENDATIONS

(1) In all ileostomy patients, serum electrolyte should be routinely estimated on the 5th post operative day.
(2) In all patients who undergo ileal resection along with ileostomy, or who have high ileostomy output, should be closely monitored for electrolyte derangement from the 3rd post operative day onwards.
(3) No definite regime of serum electrolytes replacement can be recommended. Replacements of fluids and electrolytes have to be individually tailored based on the post operative electrolyte monitoring.

Assessment of the electrolytes status is required when necessary in case of colostomy.

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