

Studies on the use of Intravenous Fluid (Management) in the First Week of Post Operative Period of Gastrointestinal Surgery.

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ABSTRACT

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Fluid and electrolyte management is the critical factor and integral part of the care for surgical patients post operatively, reducing morbidity and mortality. The present aim of the study was to assess the electrolyte level of the patients before and after surgery, prescribing pattern of I.V.Fluids, correlation of their use in maintaining electrolyte and fluid balance and assessing the cost of I.V.Fluids in relation to the total medication cost. The study was prospective observational, approved by Institutional Human Ethics Committee (IHEC). Out of 97 patients involved in the study 58(59.79%) were male and 39(40.2%) female. Among them perforation (52.57%) was highest in incidence. In the study 3 patients were found with altered electrolytes. The most commonly prescribed fluids in perforation cases 35.29% (18/51) were 5%Dextrose, 5%Dextrose 0.9%Normal saline and Ringer Lactate. The recovery in terms of fluid and electrolyte balance was also found to be faster in such patients. An attempt was made to assess the cost of I.V.Fluids (i)Percentage difference in selling price where Ringer Lactate made highest margin (100%), (ii)Pharmacy A,B,C made profit on Ringer Lactate (51.42%), Electrolyte M (138%),5%Dextrose (84.61%) respectively whereas Rajah Muthaih Medical College and Hospital made highest profit from 5%Dextrose,5%Dextrose 0.9%Normal saline(14.28%). (iii) Comparison of cost of different agencies (In Indian Rupees)was done where price ranged from Rs.6.24 to Rs.72.00. This study also found that I.V.Fluids occupied 25.23% of total medication. Apart from maintaining fluid and electrolyte balance in post operative surgical patients, attempt was made to find the pharmacoeconomic use of I.V.Fluids.

Keywords: Fluid and electrolyte management, I.V.Fluids, Fluid and Electrolyte balance, pharmacoeconomics.

INTRODUCTION

The history of Intravenous Fluids (I.V.Fluids) dates back to 1656, when Sir Christopher Wren first introduced intravenous injection to a dog. Shortly after this incident in 1662, experiment on intravenous injection in humans was done where Johann D. Major injected an unpurified compound into a man's vein¹. Use of coconut water as a short term intravenous therapy for Solomon Island patient sets an example that how medical resources for intravenous hydration and resuscitation of critically ill patients may be limited in remote regions of world.² Administration of I.V.Fluids is one of the most significant advances in the care of post operative surgical patients mainly due to wider use of drugs being administered as injections. I.V.Fluids are sterile solutions of simple chemicals such as sugar, amino acids or electrolytes, the materials which can be easily carried by

circulatory system and assimilated.³ The body of an average healthy adult consists of 60% of water, also consisting of electrolytes distributed in 2 basic compartments i.e., intracellular, extracellular compartment hence maintaining equilibrium. Water and electrolytes are utilized in various bodily functions^{4,5}. The fluid lost may be due to altered physiological conditions or due to trauma in hospitalized patients. The primary goal of fluid administered to stabilize systematic haemodynamics and microcirculation by rapidly restoring circulating plasma volume⁶. The standard fluid therapy includes replacement of fluid lost (basal fluid requirement, perspiration through surgical wound, loss to the third space and blood loss and exudation through the surgical wound and maintenance of physiological functions⁷. Similar concept is also given by British consensus guidelines on the I.V.Fluid therapy for adult surgical patients⁸. No clear general recommendations can be given as to patients are more likely based on personal guidelines then on research results.⁷ The inappropriate I.V.Fluids administration is a significant cause of patient morbidity and mortality and may result from either incorrect volume or incorrect type of fluid⁹. The current pharmacoeconomic picture of fluid management to date is

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very limited owing to the controversy surrounding choice of resuscitation fluid affecting the clinical decision making process¹⁰.

Objectives:

- To assess the electrolytes level of patients before and after surgery.
- To assess the prescribing pattern of I.V.Fluids.
- To correlate the use of I.V.Fluids and maintenance of electrolyte and fluid balance.
- Assessing the cost of I.V.Fluids in relation to the total medication cost.

METHODOLGY

The study was prospective observational study approved by Institutional Human Ethics Committee (IHEC).It was conducted for a six months period i.e., from November 2010-April 2011 at Rajah Muthaiah Medical college and Hospital (RMMC and H) a tertiary care medical teaching hospital, Annamalai University in Chidambaram, Tamil Nadu.

Patient enrollment :

Patients undergoing elective and emergency gastrointestinal (G.I.) surgery of either sex above 18years, who consented to participate in the study were included. Patients who had significant renal and hepatic impairment and pregnant women were excluded from the study. Following patient enrollment baseline data was collected on a standard data collection form which included patient name, age, gender, date of admission, date of discharge, inpatient number, reason for admission, serum electrolytes, blood urea, creatinine, fluid input and urine output, I.V.Fluids management for 7 days.

MATERIALS

1. Patient standard data collection form.
2. Prescriptions of patients.

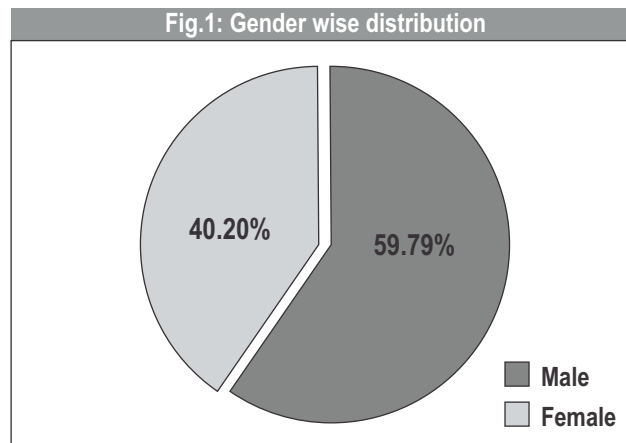
RESULTS

A total of 97 patients were enrolled in the study.

Gender wise distribution: (Table-1, Figure-1)

Out of 97 patients,58 (59.79%) were male and 39 (40.2%) female.

Table 1: Gender wise distribution		
S.NO	GENDER	NO. OF PATIENTS
1	Male	58(59.79%)
2	Female	39(40.2%)



Pattern of disease distribution: (Table-2)

Out of 97 patients,51(52.57%)were diagnosed with perforation being highest in incidence, followed by appendicitis 11(11.34%) patients and hernia 07 (7.21%)patients

Table 2: Disease distribution pattern		
S. No	Disease	No. of patients
1	Perforation	51
2	Appendicitis	11
3	Hernia	07
4	Carcinoma stomach	5
5	Intestinal obstruction	4
6	Cholethiasis	4
7	Gastric outlet obstruction(GOO)	4
8	Liver disorder	3
9	Pancreatic disorder	2
10	Carcinoma rectum	2
11	Fundal gastritis	1

Altered electrolytes and I.V.Fluids prescription:

Out of 97 patients,3 patients's electrolyte level was found to be altered.(namely X,Y,Z)

1) Patient X, was diagnosed with duodenal ulcer perforation with peritonitis with septicemia. His laboratory values are illustrated in Table-3. He was both hypernatremic (150meq/L) and hypokalemic (2.5meq/L). He was on 5% Dextrose (5%D), 0.9% Normal saline (NS), Ringer's Lactate (RL).

2) The patient Y, was diagnosed with pyloric perforation with peritonitis His laboratory values are illustrated in Table– 4. He hyperchloremic (115meq/l) and blood urea level was found to be high(67 mg/dl). He was on 5% D, 5%Dextrose 0.9%Normal saline (DNS) and RL

3) The patient Z, was diagnosed with liver abscess.His laboratory values are illustrated in Table- 5. He was slightly hyponatremic (130meq/l) and was on NS,RL

Fluid prescription in surgical patients : (Figure-2)

Overall usage of I.V.Fluids is represented with the histogram where 27 (27.83%) were prescribed with 5%D,DNS,RL.

Prescribing pattern of I.V.Fluids in 51 perforation cases: (Figure-3)

Among the 51 perforation cases; 18 patients (35.29%) were prescribed with 5%D, DNS, RL followed by 9 patients (17.64%) with 5%D, NS and 5 Patients (9.80%) with NS, RL, DNS.

Recovery (in terms of restoration of normal fluid and electrolyte balance) patients using different fluids postoperatively:

- 1) Of the 51 perforation cases, 18 were given 5%D, DNS, RL were 11 patients recovered on 3rd day. 9 were given Electrolyte-M(ISO-M) along with 5%D, DNS, RL from 5th day as electrolyte balance was not restored. (Figure-4)
- 2) The second choice was 5% D, NS where 5 patients recovered from 4th day and ringer lactate along with the above was added to correct slight electrolyte change.(Figure-5)
- 3) The 3rd choice was NS, RL, DNS and 4 patients recovered on 5th day. (Figure-6)
- 4) 5% D, DNS, RL showed 59.25% , 81.48%,88.88% improvement in day 3,4,and 5 respectively is illustrated in Table-6, Figure-7

The pharmacoeconomics of the I.V.Fluids are:

- Selling price (price in Rs.) of I.V.Fluids in various pharmacies in Chidambaram was resourced to calculate percentage difference of selling price(difference of highest and lowest price).Among all the 8 products available RL had highest margin of 100%.(Table-7,8 Figure-8)
- Procurement cost was obtained from 3 different wholesalers and profit percentage was calculated.(Table-9,10,11 Figure-9). RL (51.42%), 10%D (138%),and 5%

Table 4: Altered electrolytes patient Y

S. No	Electrolytes	Abnormal value	Normal range
1	Serumchloride (pre op)	115	96-106meq/l
	Day 7(Post op)	105	
2	Blood urea (pre op)	67	15-40mg/dl
	Day 7 (post op)	40	

Table 5: Altered electrolytes patient Z

S. No	Electrolytes	Abnormal value	Normal range
1	Serum sodium (pre op)	130	135-145meq/l
	Day 7 (Post op)	135	

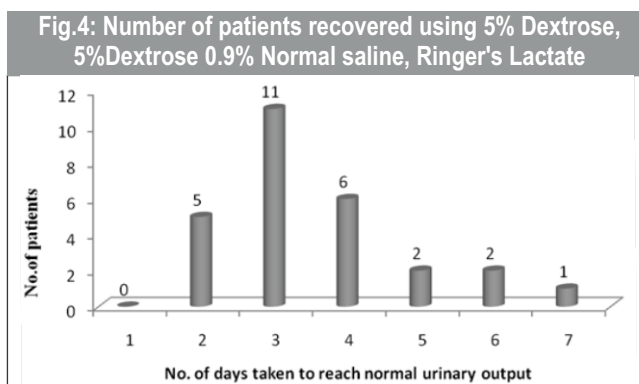
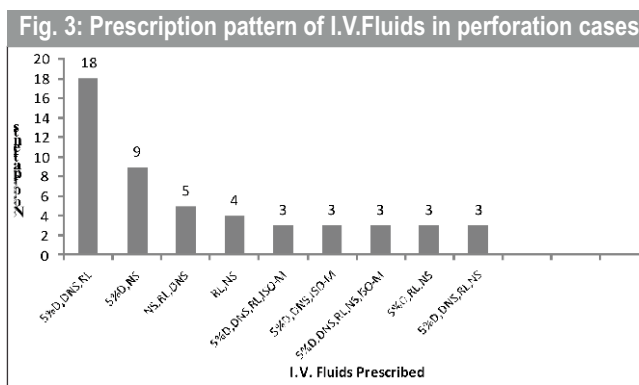
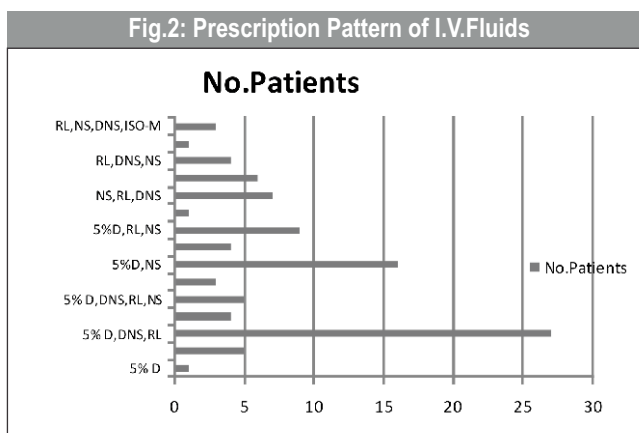


Table 3: Altered electrolytes patient X

Sr. No	Electrolytes	Observed value	Normal range
1	Serum sodium (pre op)	150	135-145meq/l
	day 11 (post op)	139	
2	Serum potassium (pre op)	2.5	3.5-5.5meq/l
	day 11 (post op)	3.6	

Fig. 5: Number of patients recovered using 5%Dextrose, 0.9% Normal saline

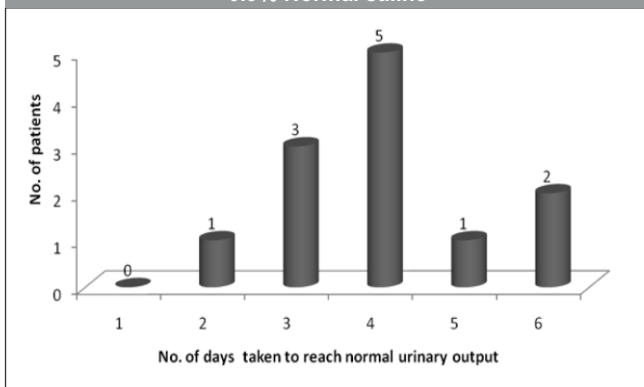


Fig. 6: Number of patients recovered using Normal Saline, Ringer's Lactate, 5%Dextrose 0.9% Normal saline

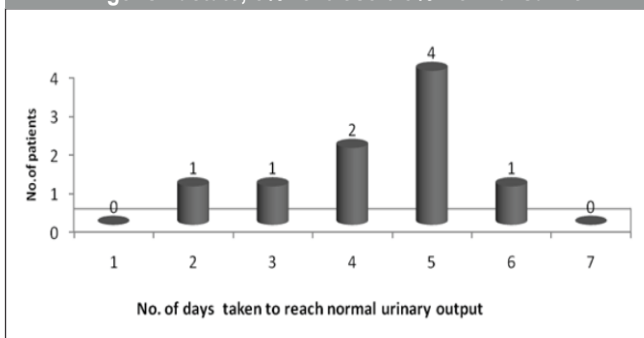


Fig.7: A statistical diagram representing % of recovery

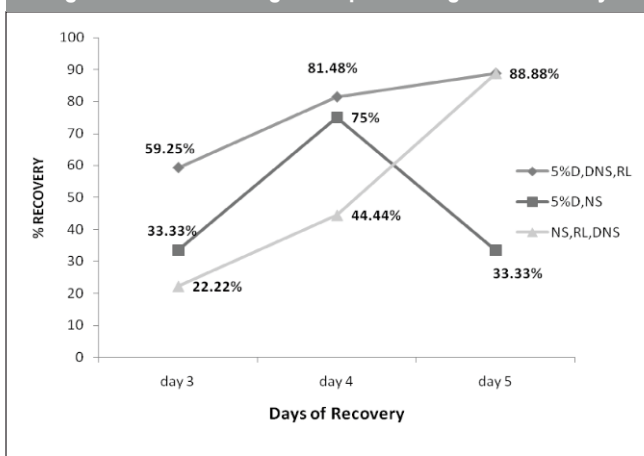


Table 6: Recovery of patients (in terms of fluid balance and electrolyte)

Sr. No	I. V. Fluids prescribed	Day 3	Day 4	Day 5
1.	5%D,DNS,RL	59.25%	81.48%	88.88%
2.	5%D,NS	33.33%	75%	83.33%
3.	NS,RL,DNS	22.22%	44.44%	88.88%

Table No.8 Percentage difference of selling price (difference between highest and lowest)

Sr. no.	V.Fluids Available	% Difference of Selling Price
1.	RL	100%
2.	DNS	4%
3.	NS	4%
4.	5%D	35.74%
5.	10%D	79.26%
6.	25%D	40.54%
7.	ISO-M	32%
8.	ISO-P	50%

Table 9: Profit percentage of I.V.Fluids in pharmacy A (Baxter)

S. No.	I.V. Fluids	Procurement cost (in Rs.)	Selling Price (in Rs.)	Profit %
1	NS	14.00	17.50	25%
2	RL	35.00	53.005	1.42%
3	5%D	14.00	17.50	25%
4	10%D	26.00	38.00	46.15%
4	ISO-M	50.00	72.00	44%
5	ISO-P	55.00	72.00	30.90%

Fig.8: % difference of selling price (between highest and lowest)

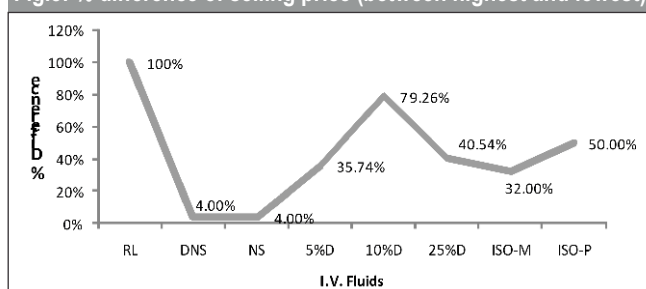


Table 7: Selling price of I.V.Fluids available in pharmacies of Chidambaram

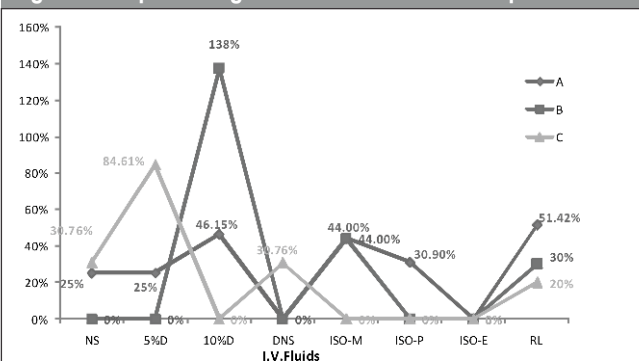
Sr. No	Manufacturer	RL	DNS	Ns	5%D	10%D	ISO-M	ISO-P	ISO-E	25%D
1	Baxter	48.5	17.68	17.63	17.68	38.49	50.00	48.00	48.00	-
2	Claris	60.0	17.68	17.68	17.68	69.00	-	-	-	-
3	Wockhard	30.0	17.00	17.00	24.00	-	-	-	-	-
4	Baxter	53.0	17.68	17.68	17.68	-	66.00	72.00	-	18.50
5	Baxter	53.0	17.50	17.68	17.68	-	-	-	-	-
6	Baxter	53.33	17.68	17.68	17.68	-	-	-	-	26.00

[Note : ISO-P (Electrolye-P) , ISO-E (Electrolye-E), 25%D (25% Dextrose)]

D (84.61%) made highest profit in PharmacyA , Pharmacy B, Pharmacy C respectively.

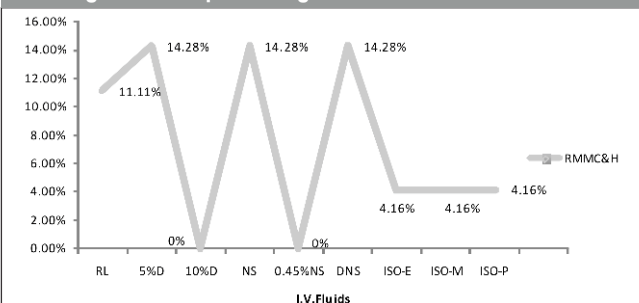
- Profit percentage was calculated for I.V.Fluids used in post operative ward of RMMC&H where highest profit was made by 5% Dextrose,5% Dextrose Normal Saline, Normal Saline (14.28%). (Table -12, Figure-10)
- Cost of I.V.Fluids in relation to the total medication cost was 25.23% (Figure-8).

Fig.9: Profit percentage of I.V.Fluids in different pharmacies.



[Note: Here 0% represents respective products are not available in pharmacies]

Fig.10: Profit percentage of I.V.Fluids in RMMC&H



[Note: Here 0% represents no gain or loss for respective products]

Fig.11: Cost of I.V.Fluids in relation to total cost of medications

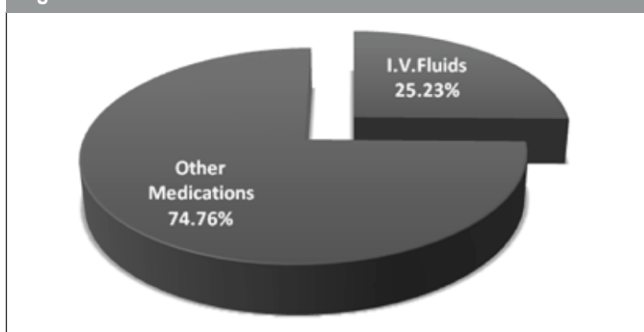


Table 10: profit percentage of I.V.Fluids in pharmacy B (Claris)

S. No.	I.V. Fluids	Procurement cost (in Rs.)	Selling Price (in Rs.)	Profit %
1	RL	50.00	65.00	30%
2	10%D	16.00	38.00	138%
3	ISO-M	50.00	72.00	44%

Table11: Profit percentage of I.V.Fluids in pharmacy C (Wockhard)

S. No.	I.V. Fluids	Procurement cost (in Rs.)	Selling Price (in Rs.)	Profit %
1	RL	25.00	30.00	20%
2	5%D	13.00	24.00	84.61%
3	DNS	13.00	17.00	30.76%
4	NS	13.00	17.00	30.76%

Table 12: Profit percentage of I.V.Fluids at RMMC & H

S. No.	I.V. Fluids 500 ml	Procurement cost (in Rs.)	Selling Price (in Rs.)	Profit %
1	RL	09.45	10.50	11.11%
2	5%D	08.75	10.00	14.28%
3	10%D	10.50	10.00	0%
4	NS	08.75	10.00	14.28%
5	0.45% NS	17.60	17.60	0%
6	DNS	08.75	10.00	14.28%
7	ISO-E	14.40	13.30	4.16%
8	ISO-M	14.40	13.30	4.16%
9	ISO-P	14.40	13.30	4.16%
10	HES	108.00	108.00	0%

[Note: HES-Hydroethyl starch, 0.45% NS- Half Saline]

Table 13: Comparison of profit percentage in the procurement cost of I.V.Fluids

Pharmacy A	Pharmacy B	Pharmacy C	RMMC&H
10%D	ISO-M	5%D	5%D,DNS,NS
(46.15%)	(114.25%)	(84.61%)	(14.28%)

DISCUSSION

Of the 97 patients enrolled 59.79% were male and 40.2% female. In the post operative surgery ward, perforation cases were high incidence (52.57%) followed by appendicitis (11.34%) and hernia (7.21%). Out of 97 patients 3 had altered electrolyte levels whose conditions are described as follows: Patient X, was on I.V.Fluids from day 0 to day 9. He was nil by mouth till 6 days and from 7th day he was given liquid diet. On the 11th day his electrolyte levels returned to normal. The patient could have been given ISO-M instead of RL which is source of potassium. The NS should have been excluded from the prescription because sodium is retained till 2-3 days

Table 14: Comparison of procurement cost of I.V. Fluid in Tamil Nadu medical service Corporation ¹², RMMC&H and Retail price in open market (price in Rs.)

Sl. No	I.V.Fluids	TNMSC	RMMC & H	Open Market	
				Lowest Price	Highest Price
1.	Sodium chloride inj.	6.24 (500ml)	8.75	17.00	17.68
2.	Sodium chloride dextrose inj I.P	6.87 (500ml)	8.75	17.00	17.68
3.	Electrolyte - P	7.35 (500ml)	14.40	48.00	72.00
4.	Electrolyte - M	7.35 (500ml)	14.40	50.00	66.00
5.	Electrolyte - E	-	14.40	48.00	-
6.	Compound sodium lactate inj I.P.	16.48 (500ml)	9.45	30.00	60.00
7.	Dextrose inj I.P.5%	6.89	8.75	17.68	24.00
8.	Dextrose inj I.P.10%	7.43	10.50	-	-
9.	Closed system I.V.Fluid (DNS 500ml)	42.00	-	-	-
10.	Closed system I.V. Fluid Ringer lactate (500 ml)	42.00	-	-	-
11.	Half saline	-	17.60	-	-

postoperatively due to release Adreno corticotrophic hormone (ACTH) following stress caused by surgery. Patient Y, was on I.V.Fluids from day 0 to 7 days. His electrolyte balance was restored within 7th days. Patient Z, was also on I.V.Fluids till 7 days. RL could have been excluded from the prescription because it is contraindicated in liver disease where lactic metabolism is impaired. No serious clinical manifestations were found in any of the patients. The results on fluid prescription in surgical patients suggested that 5%D,DNS, RL(27.83%) was widely prescribed in post operative surgery ward followed by 5%D,NS(16.49%), 5%D,RL,NS(9.27%). Prescription pattern in 51 perforation cases were also assessed in 5%D,DNS,RL (35.29%), 5%D,NS (17.64%), NS,RL,DNS (9.80%).Monitoring fluid status during post operative period can be done by assessing the parameters like recording weight of the patients on daily basis, daily urine output, urine specific gravity, measurement of urine electrolytes and creatinine clearance and central venous pressure (CVP) ¹¹. Recording urinary output on daily basis was found to more feasible in the present study. Out of 51 perforation cases, 18 were given 5%D, DNS,RL of which 11 recovered on 3rd day, for 9 patients ISO–M was also added to restore electrolyte balance apart from maintaining normal urinary output from 5th day. The second choice was 5% D, NS where 5 recovered on 4th day and RL was added along with it to correct slight electrolyte change. Use of NS,RL and DNS helped to restore in 5days. 5%D,DNS,RL showed remarkable improvement in restoring the fluid and electrolytes (59.25% on 3rd day).Various attempts were made to assess the pharmacoeconomic use of I.V.Fluids. A survey of selling price in 6 different pharmacies of 8 products available in Chidambaram was made. Percentage difference of selling price(difference between highest and lowest) ranged from 4 to 100%, where DNS was at lower margin and RL being

highest. Procurement cost was obtained from 3 different wholesalers of BAXTER, CLARIS and WOCKHARD at Pharmacy A, Pharmacy B and Pharmacy C respectively. Highest profit percentage was made from RL(51.42), 10%Dextrose (10%D)(138%), 5%D (84.61%) at Pharmacy A Pharmacy B,Pharmacy C respectively and In the post operative ward of RMMC&H profit was made from 5%D, 10%D and DNS,and of the total medication cost I.V.Fluids occupied 25.23%.

Limitations:

Weighing the patients on daily basis closely reflects changes in fluid volume. Due to lack of bed scale in our setup which is used to measure weight of the patients confined to bed, this could not be used in our study.

CONCLUSION

Body reacts to internal and environmental changes by adjusting vital functions to keep fluid and electrolyte imbalance maintaining homeostatis. The optimized electrolyte balance helps to transmit electrical impulses for survival and proper functioning of vital organs. Fluid and electrolyte management are paramount to case of surgical patient as there is considerable amount of fluid loss due to surgery and trauma. The goal of I.V. Fluid administration in post operative period of surgery is to carefully achieve evolemic and isotonic environment.

The present study aimed to assess the electrolyte level of patients before and after surgery, prescribing pattern of I.V.Fluids, correlation of the use of I.V.Fluids in restoring Fluid and electrolyte balance and to study pharmacoeconomics of I.V.Fluids.

It was found that discrepant use of I.V.Fluids prevailed while assessing the prescriptions. 3 cases of electrolyte imbalance

gives an insight. This was the result of lack practice according to recommended guidelines.

Further on assessment of prescription the study shows that based on physicians experience and practice 5%D,DNS,RL was the first choice to be prescribed and had better impact on restoration of fluid volume and electrolyte balance.

It was found that selling price (% difference of highest and lowest) of Ringer's Lactate was highest (100%) among its competitors in various pharmacies. Comparison of profit% in the procurement cost of I.V.Fluids is illustrated in Table-13. Pharmacy A gains 46.15% from 10%D, Pharmacy B gains 114.25% from ISO-M, Pharmacy C gains 84.61% from 5%D and RMMC and H gains 14.28% from 5%D, DNS, NS

Comparison of procurement cost of I.V. Fluids by different agencies(In Indian Rupees) was done where price ranged from Rs 6.24 to Rs. 72.00. (Table-14) This reveals the wide difference between wholesale price and retail price charged by the manufactures/retailers putting unreasonable burden on the consumers.

This study found that the I.V.Fluids occupied about 25.23% total medication cost which is sizeable amount requiring a thought process of rationale use of I.V.Fluids in post operative period of G.I. Surgery and hence putting into practice for the wellbeing of hospitalized patients both medically and economically.

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