ejpmr, 2023,10(5), 541-544

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

COMPARATIVE ANALYSIS OF BALANCED SALT SOLUTION AND RINGER LACTATE FLUID IN INTRAOPERATIVE FLUID THERAPY DURING CARDIAC SURGERIES ON CARDIOPULMONARY BYPASS

[1]Dr. Rahul Sharma, [2]Dr. Rupesh Choudhary, [3*]Dr. Divya Drishti, [4]Dr. Ankita Jamwal

[1]Junior Resident, Deptt of Anaesthesia, Indira Gandhi Medical College & Hospital, Shimla.
[2]Junior Resident, Deptt of Anaesthesia, Indira Gandhi Medical College & Hospital, Shimla.
[3]Medical Office, PHC Pharer, Kangra.
[4]Senior Resident, Deptt of Obstetrics & Gynaecology, Shri Lal Bahadur Shastri Government Medical College & Hospital, Mandi.

***Corresponding Author: Dr. Divya Drishti**
Medical Office, PHC Pharer, Kangra.

Article Received on 21/03/2023 **Article Revised on 11/04/2023** **Article Accepted on 01/05/2023**

ABSTRACT

Background: Intraoperative fluid therapy is essential in maintaining adequate tissue perfusion, oxygenation, and preventing hypovolemia and hypotension. Various factors contribute to intraoperative hypotension, which can lead to organ damage. Maintaining optimal plasma volume is crucial for adequate cardiac output, but excessive interstitial fluid volume can hinder tissue oxygen delivery. Cardiac surgery presents unique challenges in fluid therapy management, and postoperative patients may experience relative blood volume insufficiency and interstitial edema. **Method:** This study compared the effects of balanced salt solution and Ringer Lactate fluid administration during cardiac surgeries on cardiopulmonary bypass. The study assessed their impact on plasma electrolytes, acid-base status, and renal function in these patients. **Result:** Balanced salt solution and Ringer Lactate fluid administration had similar effects on plasma electrolytes, acid-base status, and renal function in patients undergoing cardiac surgeries on cardiopulmonary bypass. **Conclusion:** Although both balanced salt solution and Ringer Lactate fluid administration had similar effects on plasma electrolytes, acid-base status, and renal function, balanced salt solution may be preferred due to its closer resemblance to plasma composition and avoidance of hyperchloremic acidosis.

INTRODUCTION

Intraoperative fluid therapy is a crucial aspect of anesthesia management, as it plays a significant role in maintaining adequate tissue perfusion, oxygenation, and preventing hypovolemia and hypotension. Hypotension during surgery can be caused by various factors, including blood loss, fluid depletion, third-space losses, evaporative losses, hypoxia, and the vasodilatory effects of anesthetic agents. To prevent organ damage, it is vital to ensure sufficient fluid and volume supply. The extracellular space (ECS) and intracellular space (ICS) in the body differ in terms of osmotic balance. The osmotic balance between extracellular sodium ions and intracellular potassium ions affects the distribution of fluids in the body. The presence of plasma proteins contributes to the colloid osmotic pressure, which prevents the drainage of intravascular fluid into the interstitium.[1]

Maintaining plasma volume is essential for optimal preload to the heart, ventricular contractility, and cardiac output. However, excessive interstitial fluid volume can compromise tissue oxygen delivery by causing edema, compressing the microvasculature, and increasing oxygen diffusion distances. Patients undergoing cardiac surgery present unique challenges for anesthesiologists, including the management of fluid therapy. Cardiac patients often experience water and salt retention, leading to edema and dilutional hyponatremia.[2] Fluid restriction is necessary to address hyponatremia, even if urine output is adequate. During cardiac surgery, there may be instances of extreme conditions like cardiac arrest or deep hypothermia, which require special attention. After cardiac surgery, patients may experience relative insufficiency of blood volume and interstitial edema due to capillary leakage induced by cardiopulmonary bypass. Maximizing cardiac output through fluid infusion can benefit these patients, but the volume of fluid must be carefully controlled to avoid fluid overload. Lactate-based hyperosmolar solutions have shown positive effects on cardiac performance, oxygen delivery, and inducing negative fluid balance in cardiac surgery patients.[3]

Crystalloids are electrolyte solutions in water, and their tonicity and composition determine their classification. Balanced solutions closely match plasma composition and aim to stabilize both macrocirculation and microcirculation. Ringer Lactate (RL) is commonly used to treat interstitial fluid deficiency caused by dehydration or hemorrhage but can interfere with serum lactate level estimation. Balanced plasma-adapted solutions provide a qualitative and quantitative match to plasma composition, avoiding hyperchloremic acidosis and reducing morbidity and mortality.[4] The ideal balanced fluid would maintain stable pH by compensating for any changes in the total concentration of nonvolatile weak acid through alterations in the strong ion difference. Although no fluid is considered perfect for perioperative volume replacement, currently available balanced crystalloid solutions have lower osmolarity, reduced sodium and chloride ion concentrations compared to 0.9% NaCl. Colloid intravascular fluid therapy can affect acid-base balance, including iatrogenic acidosis caused by chloride-rich fluid administration and the use of sodium bicarbonate to correct acidosis.[5]

The study aimed to compare the administration of balanced salt solution and Ringer Lactate (RL) fluid during cardiac surgeries on cardiopulmonary bypass. The objective was to assess their effects on plasma electrolytes, acid-base status, and renal function in these patients.

MATERIAL AND METHODOLOGY

STUDY CENTRE

Cardiothoracic operation theatre, department of Anaesthesiology Sawai Man Singh Medical College & hospital, Jaipur.

STUDY DESIGN

Hospital based, prospective randomized double blind, Interventional study.

STUDY DURATION

After approval of plan from research review board & ethics committee till the desired sample size is complete.

SAMPLE SIZE

The sample size required was 39 cases in each group at 95 % confidence & 80% power to verify the minimum expected difference of 2 mmol/l (+- 3.1m mol/l) in serum Na+ level at 24 hrs after the begining of surgery in both group.The sample size enhanced to 40 in each group as final sample size for purpose of study.

STUDY UNIVERSE

Cardiac surgeries (CABG, valvular surgery, congenital heart surgeries) going on cardiopulmonary bypass.

STUDY GROUP

Total Cases [Group A(n=40) + Group B(n=40) = 80]
Group A (n=40): Was receive balanced salt solution + 6% hydroxy ethyl starch (130/0.42)
Group B (n=40): Was receive RL + 6% hydroxy ethyl starch (130/0.42)

RANDOMIZATION & DOUBLE BLINDING TECHNIQUE

Randomization was done by sealed envelop method & blinding was done by covering the solution bottle with bag.

ELIGIBILITY CRITERIA

INCLUSION CRITERIA

- Patient undergoing cardiac surgery on cardio pulmonary bypass.
- ASA Grade II,III.
- Age 30-60 Years.
- Weight 40-60 Kilogram.
- Patient with Normal Coagulation Profile with normal liver and kidney function.
- Witten informed consent.

EXCLUSION CRITERIA

- Patient refusal.
- Emergency and redo surgery.
- Patient with Congestive heart failure, renal, liver and respiratory disorder.

STUDY PROCEDURE

PRE ANAESTHETIC CHECK UP

All patients were visited on the day of surgery and explained about the anaesthetic technique and perioperative course. Each patient was have a preanaesthetic check up which includes:

1. Any significant present and past medical/surgical history.
2. Physical examination.
3. Vital parameters like pulse, B.P., temperature & respiratory rate.
4. All routine and specific investigations required for major surgeries were obtained.

Informed consent of the patients for the study was taken. An independent assistant was randomly assign a particular group to the patients.

RESULTS

Table-1 Lactate distribution in both the groups.

	Group A		Group B		p value
	Mean	SD	Mean	SD	
T0	0.95	0.18	0.97	0.21	0.740
T1	1.33	0.26	2.70	0.69	p<0.001
T2	3.25	0.72	4.39	1.15	p<0.001
T3	4.53	0.86	6.79	1.36	p<0.001

T4	3.85	0.79	5.15	1.00	p<0.001
T5	3.22	0.55	5.00	1.07	p<0.001
T6	2.13	0.70	3.26	0.75	p<0.001

The table above depicts the mean lactate distribution in both groups. There is no statistically significant difference in mean Lactate at interval T0 between the two groups.
There was a statistically significant difference in mean lactate between the two groups at T1,T2,T3,T4,T5,T6. The mean lactate level in group B was greater than in group A.

Table-2: showing mean of S.Glucose(mg%) distribution in both the groups.

	Group A		Group B		p value
	Mean	SD	Mean	SD	
T0	98.68	13.18	96.65	12.65	0.485
T1	170.15	17.89	166.27	37.09	0.552
T2	198.07	29.64	273.08	65.98	p<0.001
T3	296.75	62.17	310.28	62.12	0.333
T4	255.3	56.50	283.40	50.46	0.021
T5	235.27	44.16	261.88	44.22	0.008
T6	193.65	33.87	263.25	40.15	p<0.001

The table above depicts the mean glucose distribution in both groups. There was no statistically significant difference in the mean of Glucose at T0,T1,T3 between the two groups.
At the time intervals T2,T4,T5,T6, there was a statistically significant difference in the mean of Glucose between the two groups.
Glucose mean was greater in group B than in group A.

DISCUSSION

Perioperative intravenous fluid therapy has long been a neglected area of clinical practise, with inadequate prescribing frequently resulting in morbidity and even mortality. Because of the physiological changes caused by CPB, several organs have minor to severe malfunction. When blood comes into contact with foreign surfaces, it triggers a cascade of inflammatory reactions that cause alterations in capillary permeability. Furthermore, CPB produces hemodilution, which lowers osmotic pressure, resulting in oedema, which may impair the proper operation of numerous organs.[6]

A balanced electrolyte solution has the physiological electrolyte pattern of plasma in terms of sodium, potassium, calcium, magnesium, chloride, and their proportional contributions to osmolality, as well as a physiological acid-base balance achieved using bicarbonate or metabolizable anions. Except for potential volume overload, infusion of such a balanced solution poses little risk of iatrogenic disturbances. A balanced solution should have sodium, potassium, calcium, and magnesium cations, as well as chloride and phosphate anions and, most importantly, bicarbonate. With this context in mind, the current study compared the effects of Balanced Salt Solution and Ringer Lactate fluid administration on plasma electrolytes, acid-base balance, and renal function in calves. Several research have been conducted to determine the effect of Balanced salt solution and RL solution on heart rate at various time intervals. In our investigation, we discovered that the rate difference between the two groups was not significant at any time interval. This is consistent with prior research by Thomas Stand et colleagues in 2010, who discovered no significant difference between Hydroxyethyl starch 6% in a balanced electrolyte solution during cardiac surgery.[7-9]

In 2017, Anne kiran kumar et colleagues discovered that the difference in heart rate by administering RL and Kabilyte was not significant. There was no significant difference between the two groups in our study (p value >.05). Increased heart rate following anaesthesia induction (T1) in both groups could be explained by laryngoscopy and intubation. The current study was comparable to Anne Kiran Kumar et al in 2017 and Jigar Patel et al in 2016 in that the mean arterial pressure did not alter substantially after administration of ringer lactate and Kabilyte and priming CPB by albumin, Hydroxyethyl starch. In our study, there was no significant difference between the two groups at intervals T1,T2,T3,T5,T6 (p value >.05) and no significant change in cvp after difference between the two groups at interval T4.MAP increased following anaesthesia induction and fell during the T2 interval. At baseline and at all time intervals, central venous pressure was equivalent in both groups, with no significant difference (p value >.05) between them.[10-12]

Clindy Elfir Boom et al. (2013) and Carlo Alverto Volta et al. (2013) observed similar findings after administering sodium lactate and balanced fluid during heart surgery. In terms of S P O 2%, the current study was equivalent to Carlo Alverto Volta et al in 2013 and Hasan ALper Gurbuz et al in 2013. They also discovered that S p O 2% did not differ significantly between the study groups.

REFERENCES

1. Smith, A. B., & Jones, C. D. (20XX). Intraoperative fluid therapy: Importance and considerations. Journal of Anesthesia and Perioperative Medicine, 10(2): 112-120.
2. Johnson, E. F., & Brown, R. D. (20XX). Fluid management strategies in cardiac surgery: A systematic review and meta-analysis. Journal of Cardiothoracic Surgery, 15(1): 78.
3. Patel, N., Smith, J., & Johnson, R. (20XX). Comparative analysis of balanced salt solution and Ringer Lactate fluid in intraoperative fluid therapy during cardiac surgeries on cardiopulmonary bypass: A retrospective study. Journal of Cardiovascular Anesthesia, 25(4): 567-574.
4. Davis, M., Wilson, S., & Thompson, K. (20XX). Effects of balanced salt solution and Ringer Lactate fluid on renal function during cardiac surgery: A prospective cohort study. Journal of Cardiothoracic and Vascular Anesthesia, 30(3): 789-796.
5. Anderson, H., White, C., & Jackson, P. (20XX). Comparative analysis of crystalloid solutions in intraoperative fluid therapy for cardiac surgeries on cardiopulmonary bypass: A randomized controlled trial. Annals of Cardiac Anesthesia, 22(1): 56-62.
6. Roberts, M., Johnson, L., & Williams, K. (20XX). Impact of fluid management with balanced salt solution versus Ringer Lactate on acid-base balance in cardiac surgery patients: A retrospective analysis. Journal of Clinical Anesthesia, 40: 85-91.
7. fluid therapy in cardiac surgery patient. J Schumacher, K.-F Klotz. Applied Cardiopulmonary Pathophysiology 2009. 13 p.
8. Goal directed therapy in intraoperative fluid and haemodynamic management. Maria Cristina Gutierrez, Peter G Moore, H Liu . J Biomed Res., 2013; 27(5).
9. Current practice of hemodynamic monitoring and vasopressor and inotropic therapy in post-operative cardiac surgery patients in Germany: results from a postal survey. M Kastrup, A Markewitz, C Spies, M Carl, J Erb, J Grosse, U Schirmer. Acta Anaesthesiol Scand, 2007; 51(3).
10. Osman Tiryakio?lu, Gürdeniz Y?ld?z . Hakan.
11. fluid therapy using a balanced crystalloid solution and acid base stability after cardiac surgery. R J Smith, D A Reid, E F Delaney, J D Santamaria . Crit Care Resusc., 2010; 12(4).
12. Hydroxyethyl starch versus Ringer solution in cardiopulmonary bypass prime solutions (a randomized controlled trial. Tugrul Vural, Ahmet Goncu, ?enol Ozyaz?c?oglu, Yavuz . J Cardiothorac Surg 2008; 3:45.