



A COMPARISON OF STEROFUNDIN AND RINGER'S LACTATE ON INTRAOPERATIVE ACID-BASE, ELECTROLYTE AND HEMODYNAMIC CHANGES IN MAJOR SURGERY

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ABSTRACT **Background:** Perioperative crystalloid selection may influence intraoperative acid-base balance, electrolyte profile, glucose response and hemodynamic stability. Ringer's lactate is widely used, whereas Sterofundin is an acetate/malate-buffered balanced crystalloid designed to approximate plasma composition. **Objective:** To compare Sterofundin and Ringer's lactate with respect to intraoperative acid-base status, serum electrolytes, blood glucose and hemodynamic changes in patients undergoing major elective surgery. **Methods:** This prospective, randomized, interventional comparative study was conducted from July 2023 to November 2024 at a tertiary care teaching hospital. Fifty adult patients aged 18-60 years, ASA physical status I-II, scheduled for major elective surgery under general or regional anaesthesia were randomized into Group S (Sterofundin, n=25) and Group R (Ringer's lactate, n=25). Arterial blood gas and biochemical parameters were measured at baseline, intraoperatively and postoperatively. Heart rate, blood pressure, mean arterial pressure and oxygen saturation were monitored serially. Data were analysed using SPSS version 31.0; $p < 0.05$ was considered statistically significant. **Results:** Mean age, sex distribution, BMI and ASA status were comparable between groups. Serum lactate remained statistically comparable at baseline, intraoperative and postoperative time points. Intraoperative arterial pH was significantly better preserved in Group S than Group R (7.36 ± 0.05 vs 7.33 ± 0.06 ; $p = 0.048$). Intraoperative serum sodium and potassium were significantly higher in Group S, while serum chloride was significantly higher in Group R (106.1 ± 3.5 vs 103.2 ± 3.3 mmol/L; $p = 0.009$). Blood glucose was significantly higher in Group R intraoperatively and postoperatively. Heart rate, systolic pressure, diastolic pressure, mean arterial pressure and oxygen saturation were clinically comparable across groups. **Conclusion:** Sterofundin offered better intraoperative acid-base and electrolyte stability, with lower chloride load and better glycemic stability than Ringer's lactate, while maintaining comparable hemodynamic stability. It may be considered a physiologically favourable crystalloid for major elective surgery.

KEYWORDS : Sterofundin; Ringer's Lactate; Balanced Crystalloid; Acid-Base Balance; Electrolytes; Lactate; Hemodynamics; Major Surgery

1. INTRODUCTION

Perioperative fluid therapy is central to anaesthetic management because intravenous crystalloids maintain intravascular volume, tissue perfusion and cardiovascular stability during surgery. Modern perioperative practice increasingly treats fluids as pharmacologically active interventions rather than neutral volume expanders because their electrolyte composition, chloride content and buffer system can alter acid-base physiology and renal or metabolic responses [1,2]. Standard peri-operative anaesthetic management and monitoring was followed as per institutional protocol; patients were given the allocated study crystalloid during surgery and serum haemodynamic parameters were recorded at predetermined intervals.[3,4]

Ringer's lactate is a conventional balanced crystalloid containing lactate as a metabolizable buffer. Existing evidence supports the use of balanced crystalloids over chloride-rich saline for many perioperative and critical care settings, primarily because balanced solutions are associated with less hyperchloremia and more favourable acid-base profiles [4-7]. However, direct adult surgical evidence comparing Sterofundin with Ringer's lactate remains comparatively limited. Therefore, the present study compared Sterofundin and Ringer's lactate in patients undergoing major elective surgery, with emphasis on intraoperative acid-base status, electrolytes, blood glucose and hemodynamic parameters.

2. MATERIALS AND METHODS

This was a prospective, randomized, interventional comparative study conducted in the Department of Anaesthesiology and Critical Care at Bharat Ratna Late Shri Atal Bihari Vajpayee Memorial Medical College and Hospital, Rajnandgaon, Chhattisgarh, India, from July 2023 to November 2024. Institutional Scientific and Ethics Committee approval was obtained before initiation of the study, and written informed consent was taken from all participants. The study was registered under CTRI/2024/06/069501.

Fifty patients aged 18-60 years, with ASA physical status I-II and BMI

between 18.5 and 35 kg/m², scheduled for major elective surgery under general or regional anaesthesia were included. Patients refusing participation and those with renal failure, cardiac failure, liver failure, congenital or acquired cardiac anomalies, hypervolemic states, severe generalized edema, pre-existing electrolyte imbalance, metabolic acidosis, congestive cardiac failure, pregnancy or psychiatric disorders were excluded.

Sample size was based on the study by Shariffuddin et al. comparing Sterofundin and Ringer's lactate in children [7]. Participants were allocated through block randomization using sealed opaque envelopes into Group S, receiving Sterofundin, and Group R, receiving Ringer's lactate. Each group included 25 patients.

Arterial blood samples were collected in heparinized syringes at baseline and at the end of surgery. Parameters assessed included pH, pO₂, pCO₂, bicarbonate, base excess, lactate, sodium and chloride. Blood glucose was monitored hourly. Primary outcomes were changes in acid-base status and serum electrolytes; secondary outcomes were hemodynamic changes, blood glucose, urine output and core temperature. Statistical analysis was performed using SPSS version 31.0. Continuous variables were expressed as mean $\pm$ SD, categorical variables as frequencies and percentages. Unpaired t-test, Mann-Whitney U test, Chi-square test and Fisher's exact test were used as appropriate. A p value < 0.05 was considered statistically significant.

3. RESULTS

The study included 50 patients, 25 in each group. Mean age was comparable between Group S and Group R (29.64 ± 10.25 vs 34.36 ± 11.48 years; $p = 0.112$), although age category distribution differed significantly. Sex, BMI and ASA physical status were comparable between the two groups.

Table 1. Baseline Demographic and Clinical Characteristics

Parameter	Group S (Sterofundin) n=25	Group R (Ringer's lactate) n=25	p value
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Age (years)	29.64 ± 10.25	34.36 ± 11.48	0.112
Male/Female	14/11	13/12	0.78
Normal BMI	9 (36%)	8 (32%)	
Overweight BMI	11 (44%)	12 (48%)	
Obese BMI	5 (20%)	5 (20%)	0.96
ASA I/II	15/10	14/11	0.77

The acid-base, electrolyte and glucose parameters in table 2 reveal that significantly better preservation of pH during the operation, lower chloride levels and lower blood glucose can be achieved with Sterofundin.

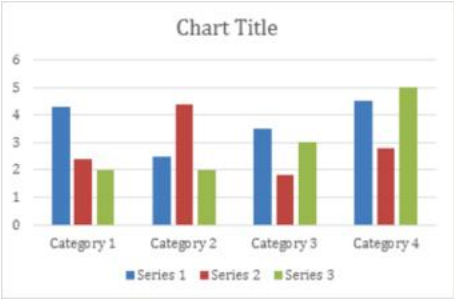
Table 2. Acid-base, Electrolyte and Glucose Parameters



Time Point	Sterofundin	Ringer's Lactate
Intraoperative	103.2	106.1
Postoperative	102.8	104.3

The intraoperative haemodynamic parameters were similar between the two groups (Table 3).

Table 3. Selected Hemodynamic Parameters



Time Point	Sterofundin	Ringer's Lactate
Intraoperative	118.13	128.70
Postoperative	110.40	119.60

4. DISCUSSION

The present study found that both Sterofundin and Ringer's lactate were safe for intraoperative fluid administration in major elective surgery, but Sterofundin produced more favourable intraoperative metabolic profiles. The most relevant differences were better arterial pH preservation, lower chloride burden and improved glycemic stability in the Sterofundin group. These observations are physiologically plausible because Sterofundin uses acetate and malate as buffers, whereas Ringer's lactate relies on lactate metabolism [3,8].

The finding of better acid-base preservation with Sterofundin agrees with previous comparative studies in scoliosis surgery and pediatric surgical populations, where Sterofundin demonstrated more stable metabolic profiles than Ringer's lactate [5,7,9]. Similar support comes from studies comparing acetate-based and lactate-based solutions in abdominal, gastrointestinal and thoracic surgeries, where acetate-buffered solutions were associated with reduced metabolic acidosis or more favourable acid-base parameters [10-12]. The present results suggest that Sterofundin offers superior maintenance of acid-base balance, decreased chlorides and improved glycemic control without affecting the hemodynamic status. The results of these observations are in line with previous studies showing the metabolic benefits of acetate buffered balanced crystalloid.

5. CONCLUSION

Sterofundin provided better intraoperative acid-base and electrolyte stability than Ringer's lactate in patients undergoing major elective

surgery. While providing similar hemodynamic stability, Sterofundin showed improved preservation of acid-base balance, a reduced chloride load and improved glycemic stability. It may therefore be considered a physiologically favourable balanced crystalloid for major elective surgery."

Declarations

Ethics Approval: Institutional Scientific and Ethics Committee approval was obtained before study initiation.

Clinical Trial Registration: CTRI/2024/06/069501.

Consent: Written informed consent was obtained from all participants.

Funding: Not stated in the source thesis.

Conflicts of Interest: Not stated in the source thesis.

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