



Comparison of Acid-Base and Electrolytes
Imbalance in Normal Saline and Bicarbonate
1/6 Molar Intravenous Fluid Infusions during
Cervical and Lumbar Laminectomy: A Pilot
Double-Blinded Clinical Trial



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Introduction



- ❧ Fluid therapy is an essential part of surgeries. Nearly all patients with general anesthesia should receive some intravenous (IV) fluids.
- ❧ Evidence shows that fluid therapy during surgeries has a dramatic effect on surgery results in the long-run .
- ❧ In general, two groups of serums, crystalloid and colloid, are more commonly used for fluid therapy during surgeries.



Introduction



☞ Achieving an appropriate effective circulating volume and assuring oxygen delivery to tissues are the goals of fluid therapy which are provided by a high volume of crystalloid, usually ringer and normal saline.



Introduction



- ❧ Acid-base balance is of great importance as the life of patients depends on it.
- ❧ In patients undergoing general anesthesia, acid-base disorders followed by cardiovascular, muscular, and respiratory dysfunctions as well as central nervous system disorders are highly prevalent.



Introduction



✧ This prospective study was done to evaluate the prevalence of electrolyte and acid-base imbalance in the common fluid therapy method (normal saline) and the use of 1/6 molar sodium bicarbonate with normal saline in cervical and lumbar laminectomy surgeries for decreasing the incidence of metabolic acidosis and achieving an improvement in fluid therapy.



Materials and Methods



✧ This double-blind clinical trial was carried out on 35-70 year-old patients referring to Baqiyatallah Hospital in 2014 with American Society of Anesthesiologists (ASA) physical status class I that were considered candidates for cervical and lumbar spinal laminectomy by the same neurosurgeon.



Materials and Methods



Patients with chronic kidney disease (CKD), hepatic failure, electrolytes imbalance, changes in blood pressure more than 30% of basal amount, need for blood transfusion before and during operation, intestinal preparation before operation, and need for lower PaCO₂ less than 35 mmHg were excluded from the study.



Materials and Methods



- ❧ Patients were visited the night before operation and randomized into two groups by a computer-generated randomization list.
- ❧ A blood sample was taken from IV line before IV fluid was infused and an arterial blood sample was taken for arterial blood gases' analysis.



Materials and Methods



- ❧ A Foley catheter was fixed for all patients and urine output was measured. Fluids needed were calculated in checklists.
- ❧ Maintenance fluid therapy was done using normal saline and deficit fluid therapy was carried out using 1/6 molar sodium bicarbonate in the first group, whereas maintenance and deficit fluid therapies were done using normal saline in the second group.



Materials and Methods



- ❧ The molar sodium bicarbonate was produced using 150 mL sodium bicarbonate 7.5% added to 850 mL infusible distilled water identical in shape and size to normal saline fluid by another anesthesiologist.
- ❧ Drug prescriber, who filled the checklists in all stages as well as the person who performed the analysis were unaware of the infused fluid in both groups.



Results



Fourty patients (15 male and 25 female patients) with the mean age of 49.9 ± 12.7 years and the mean weight of 71.9 ± 9.2 kg were evaluated. The mean operation time was 168.8 ± 36.6 minutes. There were no significant differences in demographic data and operation time between the two groups ($P > 0.05$).



Results



- ∞ The mean blood loss was 382.1 ± 189.4 ml and the mean urine volume was 379.5 ± 152.1 ml. There were no significant differences between the two groups in blood loss, urine volume, and fluid volume needed ($P > 0.05$).
- ∞ The mean fluid infused volume was 3.51 ± 0.85 liters; this volume was 3.58 ± 0.83 liters in the bicarbonate group and 3.44 ± 0.89 liters in the normal saline group ($P = 0.641$).



Results



There was not a significant difference in mean pH before the operation between the two groups ($P=0.605$). Mean pH significantly decreased after operation in the normal saline group ($P<0.001$).



Results



Before operation, there were also no significant differences in PCO_2 and HCO_3 values between the two groups ($P > 0.05$). Mean PCO_2 and HCO_3 values significantly increased in the bicarbonate group, whereas they presented significant decreases in the normal saline group ($P < 0.05$).



Results



There were no significant differences in preoperative lactate, sodium, potassium, and Cl⁻ values between the groups ($P > 0.05$). The mean lactate value significantly increased after operation in the bicarbonate group ($P = 0.002$), whereas the mean Cl⁻ amount significantly increased in the normal saline group ($P = 0.003$).



Discussion



∞ The results of this study showed that molar sodium bicarbonate serum has a superiority in controlling acid-base imbalance compared to the current fluid therapy method with normal saline in patients undergoing cervical and lumbar laminectomy surgeries.



Discussion



✧ In a systematic review on assessing various crystalloids by Cortes et al., more pH reductions, higher acidosis incidence, and lower bicarbonate levels were reported for normal saline compared to ringer lactate and ringer acetate.



Discussion



- ❧ Tie et al. assessed five clinical trials and observed that sodium bicarbonate prescription had no significant effect on the hospitalization duration, mortality rate, and incidence of atrial fibrillation following coronary artery bypass graft surgery.
- ❧ However, ventilator requirement, ICU admission time, and incidence of alkalosis significantly increased by prescribing bicarbonate. This study did not indicate that prescription of bicarbonate prevented the incidence of renal failure due to cardiothoracic surgeries.



Discussion



✧ In a similar study by Turner et al., sodium chloride and sodium bicarbonate serums were compared. Overall, 24% of sodium chloride and 27% of sodium bicarbonate groups were afflicted by post-surgical acute kidney injury. In this study, sodium bicarbonate did not have a decreasing effect on the incidence of acute kidney injury following cardiothoracic surgeries.



Discussion



- ❧ The importance of renal failure prevention in hospitalized patients, especially severely ill ones, has been emphasized by Schiffl.
- ❧ He observed that applying sodium bicarbonate was not effective in preventing renal failure because of increased mortality risk. Schiffl suggests more clinical trials for better decision making.



Discussion



Haase et al. studied 100 CABG patients and reported sodium bicarbonate (4mmol/kg) to significantly increase plasma bicarbonate level, base excess, and urine pH in comparison with sodium chloride (4mmol/kg). Increases in plasma creatinine and urea were significantly lower in the sodium bicarbonate group.



Conclusion



Based on the results of this study, it can be concluded that the incidence of acid-base imbalance following lumbar laminectomy surgery significantly decreases by applying 1/6 molar sodium bicarbonate serum.



Suggestion



- ❧ Considering the limited sample size in this pilot study, more clinical trials are needed for confirming its results.
- ❧ Future studies can also compare this fluid with ringer lactate, acetate, and bicarbonate serums in other surgeries.
- ❧ It is also suggested that in future studies prescription of different doses of bicarbonate be assessed before, during, and after surgery.



Thanks for your kind attention!