Research Paper

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Effect of Alkalinizing Local Anaesthtic in Epidural Anaethsia-an Evaluation Using 7.5% Sodium Bicarbonate

Medical Science

KEYWORDS : Sodium bicarbonate, Epidural, Lidocaine

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ABSTRACT

Efforts to find a better adjuvant in regional anesthesia are underway since long. Many agents were proved to be effective in providing a same pharmacological benefit by different mechanisms of action. In this study we sought to investigate the effect of alkalinising a local anesthetic.

Objective: To evaluate the efficacy of Sodium bicarbonate as an adjuvant to Lidocaine in epidural anesthesia.

Methodology: Sixty patients scheduled for lower limb trauma orthopaedic surgeries under epidural anesthesia were divided into two groups C and S with 30 in each. Patients in group C received 12.5ml of 2% Lidocaine + 1.5ml Normal saline making a total volume of 14ml. Patients in group S received 12.5ml of 2% Lidocaine + 1.5ml of 7.5% Sodium bicarbonate making a total volume of 14ml. Onset, time for peak sensory level, time for two segment regression and the total Mephentaramine consumed to maintain the hemodynamics were recorded, tabulated and statistically analysed.

Results: The onset of sensory block and the time for attaining peak sensory level were quicker in group S. The time for two segment regression and the requirement of Mephentaramine were similar in both the groups.

Conclusion: Sodium bicarbonate is effective in hastening the onset and spread of sensory blockade when used as an adjuvant to epidural Lidocaine, but does not have much influence on the duration of anesthesia and the hemodynamic stability.

Introduction

Interruption of pain is central to the anesthetic practice. Development of epidural analgesia played a significant role in man's triumph over pain, which undoubtedly is one of the most fascinating chapters in the history of medicine. Onset, duration and the quality of neuraxial blockade in epidural anesthesia depend on the type of local anesthetic agent used and are significantly influenced by the addition of an adjuvant. Efforts to find a better adjuvant in regional anesthesia are underway since long. Sedation, stable hemodynamics and an ability to provide smooth and prolonged post operative analgesia are the main desirable qualities of an adjuvant in the neuraxial anesthesia. In anesthetic practice, there has been a considerable interest in the effect of pH on the onset, potency and duration of blockade of local anesthetics. It is said that alkalinisation of local anesthetic improves the quality of block by influencing the portioning coefficient of anesthetic between aqueous solution and biological membranes1. Thus in this study we sought to evaluate the efficacy of Sodium bicarbonate as an adjuvant to Lidocaine in epidural anesthesia.

Objectives:

To evaluate the efficacy of Sodium bicarbonate as an adjuvant to epidural Lidocaine in terms of onset of sensory block, time for attaining peak sensory level, time for two segment regression from the peak level and requirement of vasopressor by comparing with a placebo.

Methodology

Approval from the institutional ethics committee was obtained before starting the study. Written informed consent was obtained from all the patients who were enrolled in the study. In this randomized, double blinded prospective study, all adult patients belonging to the ASA status 1 and 2 with recent[less than 48 hours] lower limb trauma scheduled for orthopaedic surgeries from July 2013 to December 2013 were included. Patients with gross spinal abnormality, localized skin infection, neural disease, severe valvular heart disease, shock, hypertension, diabetes mellitus, pulmonary/hepatic/renal diseases, peripheral neuropathy, psychiatric disorders, coagulation abnormalities, dysrrhythmias and patients on beta blockers were excluded from the study. Patients were randomly allocated into two groups S and C using a computer generated randomization programme. In the operating room, after connecting standard monitors and securing intravenous[IV] access, base line blood pressure and heart rate were recorded and preloading was done with 500ml crystalloid solution. Epidural space was engaged in sitting position in L4-5/L3-4 inter vertebral space with 18G Tuohy needle using 'loss of resistance to air' technique under strict aseptic precautions. 20G epidural catheter was threaded and fixed at 3 to 5 cm in the epidural compartment after excluding intravascular and intrathecal placement by giving test dose with 2% lidocaine with adrenaline(1:200000). Patients in group S received 12.5ml of 2% Lidocaine + 1.5ml of 7.5% [weight/volume]Sodium bicarbonate solution making a total volume of 14ml. Patients in group C received 12.5ml of 2% Lidocaine + 1.5ml of Normal saline making a total volume of 14ml. The study drugs were drawn by an anesthetist who was blinded to the study, coded and handed over to another anesthetist who was blinded to the drug for administration. After administering the drug, the time point when the pain at the movement of the fracture site disappeared was taken as onset of sensory block. The peak sensory level attained was recorded with pin prick and the time was documented. The time for two segment regression from the peak sensory block was also recorded. Mean arterial pressure[MAP] and heart hate[HR] were documented every 5minutes. Hypotension of more than 20% of the baseline was treated with 6mg boluses of IV Mephentaramine and the total consumption was documented. All the observations were tabulated and analysed statistically.

Statistical analysis:

Over all power of the study was calculated by using 'Online power and sample size calculator for K means'. Power of the study for comparison between two groups was calculated using online power calculator for difference between two means. Summarization of the data was done with the help of measures of central tendency and dispersion[Mean and Standard deviation]. Differences between average values of different parameters under study were calculated with the help of t-test of difference between two independent sample means. Z-test of proportions was used to test the differences in proportions of males and females between the groups. t-test and Z-test were done with the help of ' In-Silico project support for life sciences online calculator'.

Results

A total of 63 patients were enrolled in the study, out of which 3 patients were excluded due to failure of epidural anesthesia. Thus 60 patients were included in the study with 30 in each group. Power of the study for the said sample size was calculated to be 98%. The demographic profile was comparable between the two groups[Table-1 and 2]. The average onset of sensory block was quicker in group S as compared to that in group

C and the difference was statistically highly significant[Table-1]. The average time for attaining peak sensory level was also quicker in group S than in group C which was statistically significant[Table-1]. However the average time for two segment regression and the average Mephentaramine requirement were almost similar in both the groups.

Discussion

The advantage of epidural anesthesia over spinal anesthesia is the liberty of titrating the dose of local anesthetic to the effect along with the freedom of extending the duration of anesthesia when surgery is getting prolonged. Absence of dural puncture and post operative analgesia are the other benefits of epidural anesthesia over spinal anesthesia. Early onset is one important aspect where the sub arachnoid block has an edge over epidural anesthesia which usually takes 20 to 30 minutes to act. Addition of an adjuvant to the local anesthetic can minimize this delay. An ideal adjuvant should not only hasten the onset of action of local anesthetic but also facilitate reduction in it's dosage along with providing hemodynamic stability and an optimal sedation. Literature reveals several clinical trials studying the role of various pharmacological agents viz Opioids2, Benzodiazepines3, Dexamethasone4, Neostigmine5, Magnesium sulfate6, Sodium bicarbonate and Alpha-2 adrenergic agonists as adjuvants to local anesthetics in epidural compartment.

Adding Sodium bicarbonate to Lidocaine hastens the onset and enhances the depth of epidural blockade. The increase in pH increases the extra-neural amount of non-ionized local anesthetic, which is the form that diffuses through the lipid phase of the neural membrane7. CO2 produced by the addition of bicarbonate and bicarbonate per se reduce the margin of conduction safety of the neural membrane8. Moreover, CO2 penetrates into the nerve, where it may determine trapping of the active cationic form of local anesthetic by acidifying the axoplasm8 . Several studies have shown that addition of Sodium bicarbonate hastened the onset of action of Lidocaine in the epidural space9,10 which was not observed in few other studies11.

In our study we observed that the onset of action in Sodium bicarbonate group was quicker[average 178.67 sec] than in control group[average 642sec]. The speed of onset observed is almost on par with that in spinal anesthesia. The time for attaining peak sensory level was also faster in Sodium bicarbonate group[15.67minutes] than in control group[23.33minutes] suggesting that Sodium bicarbonate can provide quicker onset and a faster spread of sensory blockade when added to a local anesthetic in epidural anesthesia. The average time for two segment regression was however observed to be similar in both the groups suggesting that Sodium bicarbonate does not alter the duration of sensory blockade. The average Mephentaramine requirement was also observed to be similar in both the groups suggesting that Sodium bicarbonate does not have much influence on hemodynamics. In this study, we used 12.5ml of 2% Lidocaine for epidural anesthesia as all the surgeries were on lower limb. Higher volumes are certainly required for abdominal procedures wherein the concentration of the local anesthetic needs to be reduced to avoid toxicity which may jeopardize the quality of sensory and motor blockade. There is a lot of scope for further research in this area where the role of the adjuvants can be investigated in minimizing the local anesthetic dose in epidural anesthesia.

Conclusion:

We conclude that Sodium bicarbonate is effective in hastening the onset and spread of sensory blockade when used as an adjuvant to epidural Lidocaine, but does not have much influence on the duration of anesthesia and the hemodynamic stability.

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Tables

1. Analysis of comparable parameters

	Control	NaHCo3			
	Mean ± SD	Mean ± SD	t-value	P-value	Result
Age	52.77 ± 8.56	40.17 ± 15.22	1.126	0.266	No significant difference
Onset of sensory blockade (Sec)	642 ± 232.73	178.67 ± 62.7	10.53	<0.0001	Highly statistically Significant
time for peak sensory level(min)	23.33 ± 9.29	15.67 ± 7.40	3.532	0.0004	Significant
2 segmen: regression(min)	49.93 ± 17.52	55.17 ± 25.17	-0.988	0.3275	Not Significant
mephentaramine consumed(mg)	6 ± 7.22	9.00 ± 10.16	-1.582	0.1197	Not Significant

2. Analysis of gender

NaHCo3 Vs Control	Difference in proportions			
	Z-value	P-value	Result	Conclusion
Females	-0.24	0.8	Not significant	There is no significant difference in proportion of females between the two groups
Males	0.24	0.8	Not significant	There is no significant difference in proportion of males between the two groups

Figures

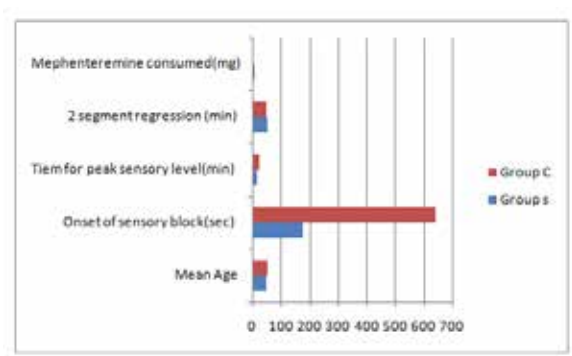

Figure 1: Sodium bicarbonate vs Control

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