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Determining the epidural space by loss of resistance technique with lidocaine 2% in comparing to normal saline 0.9% and effectiveness on onset of action and outcome of block

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Abstract
Background: The epidural space is the space that lies between the spinal meninges and the sides of the vertebral canal. It can be categorized into cervical, thoracic, lumbar and sacral epidural spaces. Identification of the epidural space is of crucial importance as it is technically demanding. Any techniques identifying the epidural space should be simple and straightforward, effective, safe, and reliable to minimize the number of complications associated with it. One of the most reliable methods in identifying the space depends on Loss of Resistance (LOR). This method of identification uses either air or a liquid such as saline or a local anesthetic to achieve it such as lidocaine.
Aim of study: This study was designed to assess the onset of single shot epidural anesthesia and reduce the volume of local anesthetic agent to reach the desired dermatome level with less associated side effects.
Methods: Fifty patients enrolled in this study was randomly divided in to two groups, twenty five patients received epidural anesthesia after detection of epidural space by using LOR technique with 3ml of normal saline(0.9%NaCl) and the other 25 patients with 3 ml of (lidocaine 2%). The two groups received 12 ml of 2% Lidocaine with Epinephrine (1:200000) every 10 min. the sensory and motor blockade level was recorded with other monitoring parameters including blood pressure.
Results: The data showed that the median time to achieving sensory readiness in lidocaine group is (8min) while in normal saline group is about (18 min) with P value < 0.01which is statistically significant, also the median time for motor blockade was about (10min) in lidocaine group and (25min) in normal saline group with P value 0.008 which is highly significant difference. There was no significant difference in the distribution of maximum sensory level and regression of block in both groups. There was significant difference in the distribution, in which Bromage score was higher in lidocaine group.
Conclusion: The use of lidocaine 2% for detection of epidural space by using loss of resistance technique was found to be faster in achieving the desired sensory and motor block in comparison with normal saline 0.9%. There were no significant differences between the two groups concerning the hemodynamic stability and regression of block.

Keywords: Determining, epidural space, normal saline, neuraxial technique, lidocaine group

Introduction
A neuraxial technique offering a range of applications wider than the typical all-or-nothing, single dose spinal anesthetic. An epidural block can be performed at the lumbar, thoracic, or cervical level. Sacral epidural anesthesia is referred to as a caudal block [1].
Any techniques identifying the epidural space should be simple and straightforward, effective, safe, and reliable to minimize the number of complications associated with it, various methods have been used in identifying the epidural space. Most of these traditional methods of locating the epidural space depend on the negative pressure exhibited during the introduction of the epidural needle into the space [2].
One of the most reliable methods in identifying the space depends on Loss of Resistance (LOR). This method of identification uses either air or a liquid such as saline or a local anesthetic to achieve it.

The technique applies continuous or intermittent pressure on the piston of an epidural glass or plastic syringe towards the barrel, and the loss of resistance is where it becomes possible to inject through the syringe attached to the epidural needle, so the piston can easily move into the barrel. This technique works because the ligamentum flavum is extremely dense, and injection into it is almost impossible. The syringe may contain air or saline. The principles are the same, but the specifics of the technique are different due to the greater compressibility of air with respect to saline or lidocaine [2].

Air and saline are widely used and accepted in syringes attached to epidural needles for determination of the LOR during the insertion of an epidural needle [3].

The most common test dose is 3 mL of local anesthetic containing 5 μg/mL of epinephrine (1:200,000). The dose of local anesthetic should be sufficient that subarachnoid injection will result in clear evidence of spinal anesthesia. Intravenous injection of this dose of epinephrine typically produces an average 30 beats per minute heart rate increase between 20 and 40 seconds after Injection [4].

Saline also can interfere with the onset and quality of pain relief provided by epidural anesthetics and analgesics. Normal saline or injectable 0.9% saline is accepted as a physiologic solution for parenteral administration within the human body. Saline with local anesthetic molecules is accepted widely to dilute the strength of local anesthetic drugs but not alter or degrade them [5]. The volume used for dilution directly parallels the reduction in potency [6].

This study was designed to study the:

1. Easy, safe and highly accurate technique to identify the epidural space.
2. Asses the onset of single shot epidural anesthesia and reduce the volume of local anesthetic agent to reach the desired dermatome level with less associated side effects.

Patients and Methods

After obtaining the scientific council of anesthesia and intensive care unit committee approval, prospective, randomized, clinical trial was carried out in major surgical operation theaters of Baghdad teaching hospital, during the period from 1st June 2015 to 30th of May 2016.

Fifty patients have been enrolled in this study. And all patients receiving epidural anesthesia, scheduled to have elective surgical procedure above knee amputation of diabetic foot disease.

Twenty five patients received epidural anesthesia after detection of epidural space by using LOR technique with the syringe filled with 3ml of normal saline (0.9% NaCl) and the other 25 patients the syringe filled with 3 ml of (lidocaine 2%). Written informed consent was obtained from all patients before enrolling them in the study.

Inclusion criteria

- ASA-PS III.
- Age: 50-70 years.
- Weight: 60-90 Kg.
- Height: 150-180 cm.
- Lower limb surgery.

Exclusion criteria

- Patient refusal.
- Any absolute contraindication to epidural anesthesia.
- Pervious back surgery.
- Vertebral column deformities.

Data collected using pre-constructed form sheet and detailed history was taken from each patient, information about patient's medical history, age, height and weight. A clinical examination was performed by general examination and vital signs measurement. Monitors (Electro-Cardio Gram (ECG), Non-Invasive Blood Pressure (NIBP), Heart Rate (HR) and Oxygen Saturation (SPO_2)) were attached after receiving patient in operation room. Base line hemodynamic variables were recorded, pulse rate, oxygen saturation and blood pressure, with sensory and motor block assessment. Patient were divided into two groups (Normal saline (N/S) group, N=25 and lidocaine group, N=25).

After taking the written patient agreement, two wide pore intravenous cannulas was done and a pre load of 15ml/Kg 0.9% N/S within 15-30 min. Under a complete aseptic condition, in a sitting position, identification the Insertion levels inter vertebral space L2-L3 or L3-L4. intervertebral space, using the midline approach, local infiltration with lidocaine 2% about 2 ml, the epidural space was located with Tuohy needle gauge 18 (B. Braun).

The loss-of-resistance method with a plastic syringe (Size 10 ml) was used to localize the epidural space with continuous pressure on the piston of an epidural plastic syringe towards the barrel, and the loss of resistance is where it becomes possible to inject through the syringe attached to the epidural needle by using the thumb of dominant hand and stabilize the needle by the other hand. Patients were randomly allocated to one of the two methods: 1) three mL of normal saline 9% (N=25), (Group Named N). 2) three mL of lidocaine 2% (N=25), (Group Named L).

If after 3 min. there was no blood or cerebrospinal fluid (CSF) aspiration, 5 mL of 2% lidocaine + adrenaline (1:200000) was administered through the Tuohy needle as a test dose in the two groups, after waiting 3 min. if no signs of subarachnoid block (lower limb paralyses) or intravascular injection (increase of heart rate more than 20-30 beat/min from base reading), then a 7 ml of lidocaine 2% with adrenaline (1:200000) administered as a single dose. A blinded independent observer recorded the evolution of sensory and motor every 10 min. until readiness for surgery where the motor blockade achieved.

Sensory block was assessed by using the pin-brick sensation loss. Whereas the motor was assessed by using a modified Bromage's score:

0 - No motor block.
1 - Hip blocked.
2 - Hip & knee blocked.
3 - Hip, knee & ankle blocked.

After readiness was achieved, the evaluated every 10 min. until 2-segment regression of the sensory dermatome level. Standard monitoring was used throughout the procedure, including electrocardiogram (lead II), heart rate, automated noninvasive arterial blood pressure & pulse oximetry, a decrease in systolic arterial pressure (MAP) ≤ 30% from the baseline was considered as clinically relevant hypotension & was treated with intra venous (IV) crystalloid infusion, with vasopressors were given as intermittent doses.

Anderson darling test was done to asses if continuous variables follow normal distribution, if follow normal

distribution than mean and standard deviation used, if did not follow normal distribution than median and interquartile range (25% to 75% percentile range) will be used to present the data (boxplot and whisker used to present them graphically).

Discrete variables presented using there number and percentage used to present the data, chi square test used to analyze the discrete variable or Fisher exact test used to analyze the distribution between 2 groups (used instead of chi square for 2x2 table, if total sample < 20 and if 2 or more with expected frequency less than 5).

Two samples t-test used to analyzed the differences in means between two groups (if both follow normal distribution with no significant outlier), while one way ANOVA used to analyzed the differences between more than two groups (if they follow normal distribution with no significant outlier), trend ANOVA used the differences in mean between the same group over 3 time periods.

When a test is used either for the purpose of screening or to exclude a diagnostic possibility, a cut-off value with a high sensitivity may be selected; or when a test is used to confirm a disease, a higher specificity may be required. SPSS 20.0.0, Minitab 17.1.0, MedClac 14.8.1, GraphPad Prism 7.0 software package used to make the statistical analysis, p value considered when appropriate to be significant if less than 0.05.

Results

Analysis of results had shown there is no difference between the 2 groups in regard of age, weight, height, gender, or duration of surgery was insignificant as p-value 0.709, 0.943, 0.341,0.774 and 0.882 respectively, as in Table 1.

Table 1: Demographic variables and duration of surgery of studied patient

Parameters	Group	Number	Mean	P-Value
Age (years)	Lidocaine	25	57.2±8.3	0.709
	NS 0.9%	25	58.2±10.4	
Weight (Kg)	Lidocaine	25	79.9±14.4	0.943
	NS 0.9%	25	79.6±13.3	
Height (cm)	Lidocaine	25	168.4±8.2	0.341
	NS 0.9%	25	166.4±6.4	
Gender(F:M)	Lidocaine	25	10:15	0.774
	NS 0.9%	25	11:14	
Duration of surgery (min.)	Lidocaine	25	70±15	0.882
	NS 0.9%	25	75±2	

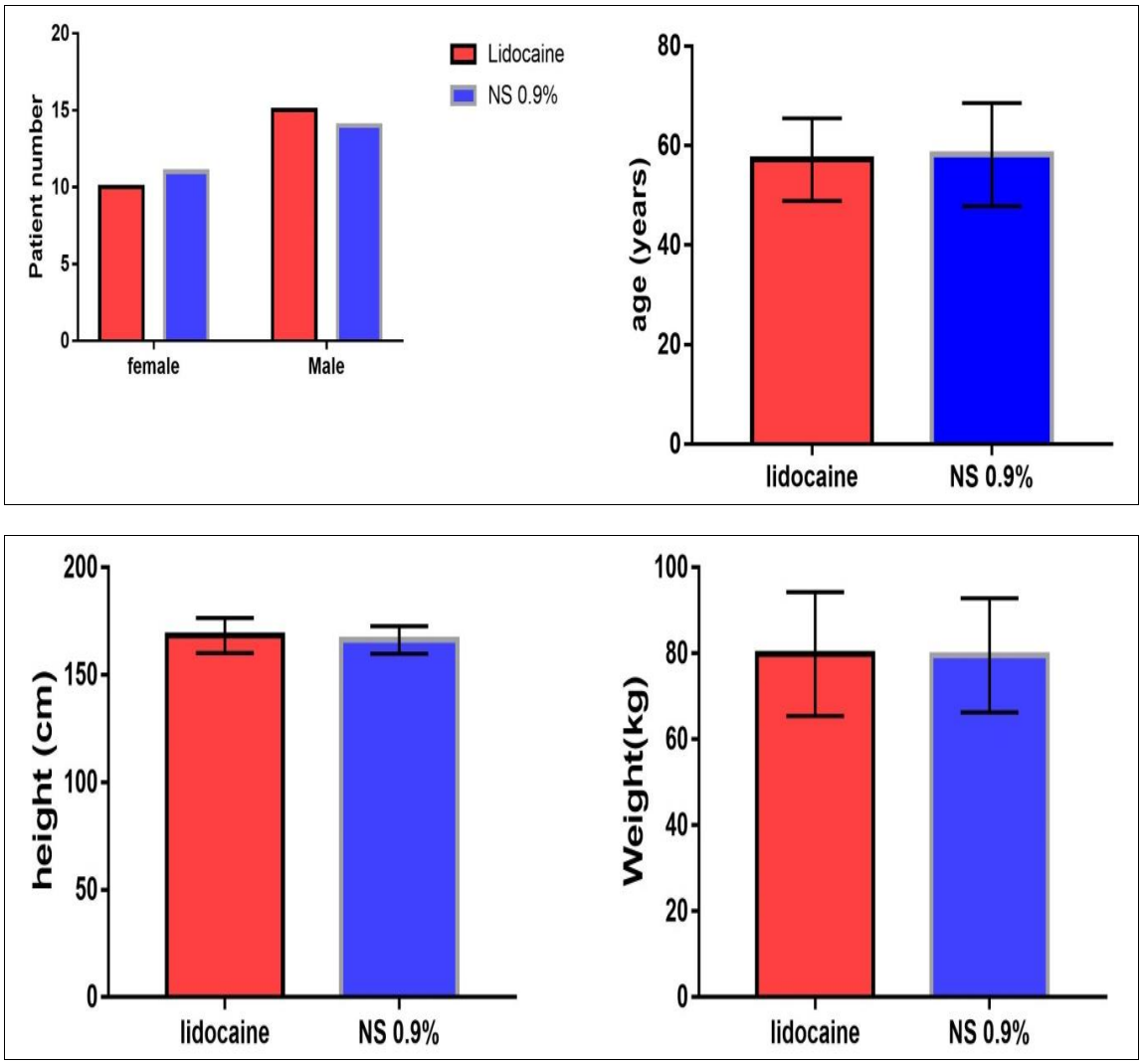

Fig 1: Demographic variables show the difference between the lidocaine & N/S groups' age, height, weight & gender

Both groups had reduce MAP significantly from 10 minutes till 20 minutes (p-value < 0.001), and start to increase MAP significantly from 20 minutes till 30 minutes (p-value = 0.022, 0.031), however there was no interaction between both treatment (i.e. both treatments behave similarly in terms of changing MAP from 0 minutes till 60 minutes.

Table 2: The difference in MAP, pulse rate & respiratory rate every 10 min throughout procedure

Parameters	Groups	0 min	10 min	20 min	30 min	40 min	60 min
MAP	Lidocaine	98±9	90±8	80±11	83±12	88±13	89±10
	NS 0.9%	99±8	94±6	83±10	89±12	93±10	93±11
	p-Value	0.741	0.080	0.217	0.075	0.114	0.172
Pulse Rate	Lidocaine	90±12	84±11	84±13	84±12	85±11	84±11
	NS 0.9%	91±10	88±10	86±12	87±11	88±10	86±10
	p-Value	0.614	0.173	0.579	0.445	0.309	0.530
Resp. Rate	Lidocaine	12±1.8	12.3±1.3	12.1±0.9	12.6±0.9	12.4±1.1	12.7±0.9
	NS 0.9%	12.4±1	12.1±0.6	11.7±0.5	12.5±1	12.2±1.1	12.7±0.8
	p-Value	0.567	0.397	0.042	0.774	0.692	1.0

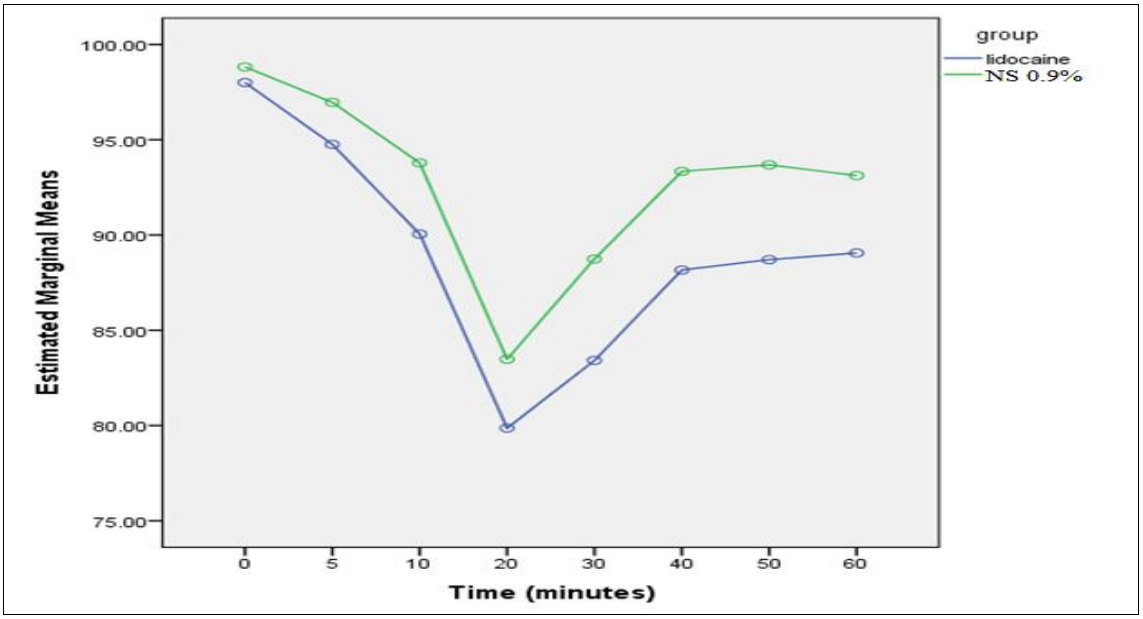

Fig 2: Mean arterial blood pressure (MAP)

Both groups had did not change PR significantly from 0 minutes till 60 minutes (p-value > 0.05), and there was no interaction between both treatment (i.e. both treatments behave similarly in terms of changing PR from 0 minutes till 60 minutes).

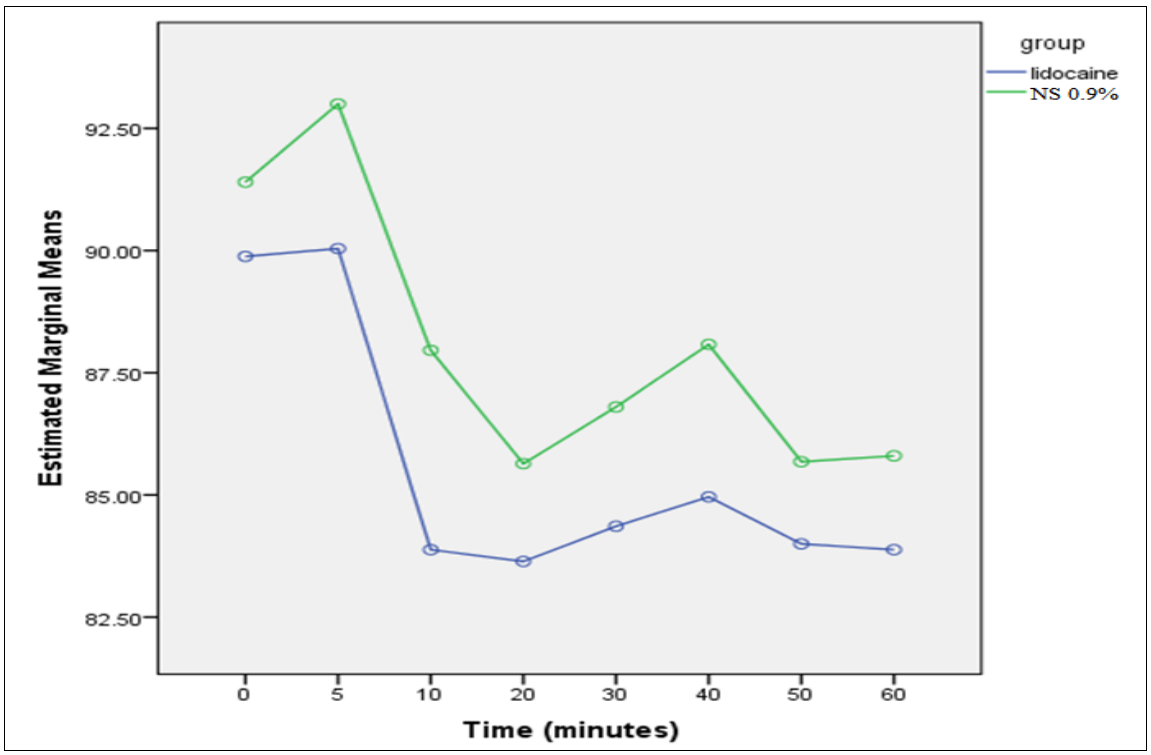

Fig 3: Pulse rate

Lidocaine group did not change RR from baseline till 60 minutes (p-value > 0.05), while NS 0.9% group had significant change in some points (10 to 20 minutes and 20 to 30 minutes) in these point there was significant changes. Overall there was no interaction between both treatments (i.e. both treatments behave similarly in terms of changing RR from 0 minutes till 60 minutes).

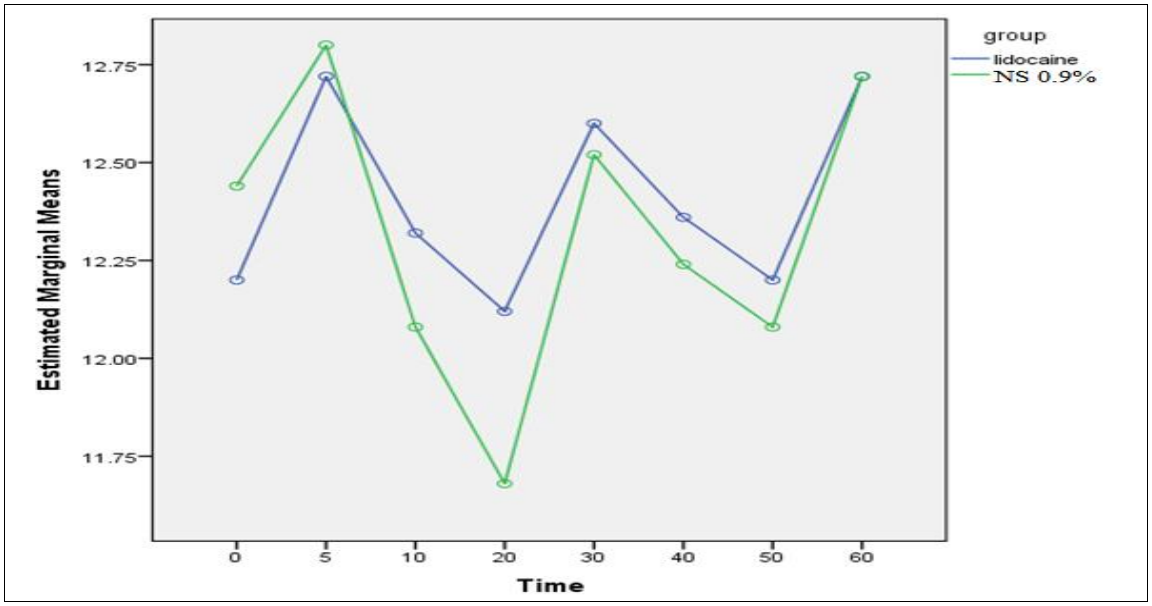

Fig 4: Respiratory rate

Lidocaine was faster in achieving sensory readiness median of 8 minutes, while NS 0.9% needed 18 minutes median time to reach readiness this difference was significant.

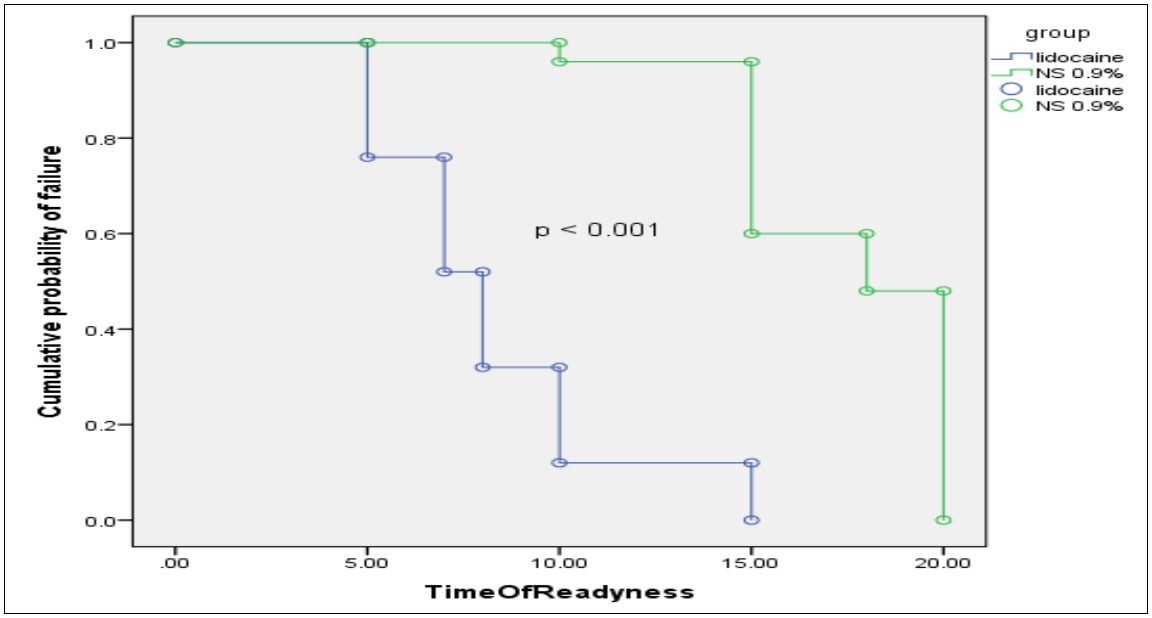

Fig 5: Cumulative probability of failure horizontal line as the lines descend toward the bottom there is increase in the rate of success, if reached 0 indicate 100% success rate.

Table 3: The difference between the lidocaine and N/S 0.9% groups in variables of time of readiness, time of achieving motor blockade, maximum sensory level & 2-segment of regression

Parameters	Groups	Number	Mean	Std. Deviation	P-Value
Time of readiness (min.)	Lidocaine	25	8.0	1.8±2.7	< 0.01
	NS 0.9%	25	18.0		
Time of achieving motor blockade (min)	Lidocaine	25	10.0	2.8±3.4	0.008
	NS 0.9%	25	25.0		
Maximum sensory level (min.)	Lidocaine	25	T10	(T_{10}-T_4)	0.62
	NS 0.9%	25	T10	(T_{10}-T_4)	
Time of 2-segment regression (min.)	Lidocaine	25	60.5	6±9	0.418
	NS 0.9%	25	65.4		

Lidocaine was faster in achieving motor blockade (median of 10 minutes), while NS 0.9% needed 25 minutes median time to reach motor blockade (this difference was significant).

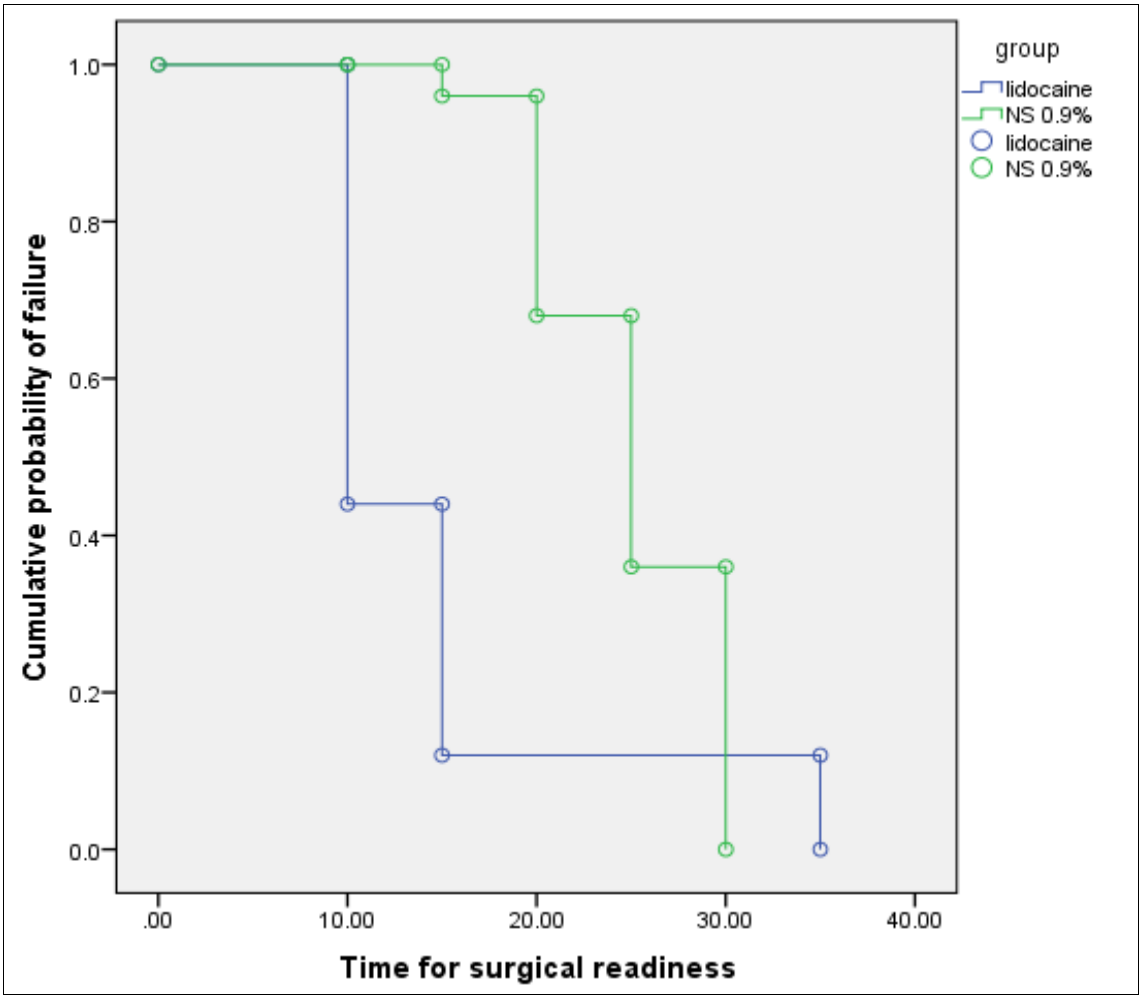

Fig 6: Cumulative probability of failure horizontal line as the lines descend toward the bottom there is increase in the rate of success, if reached 0 indicate 100% success rate

There was no significant difference in the distribution of maximum sensory level and regression of block in both groups.

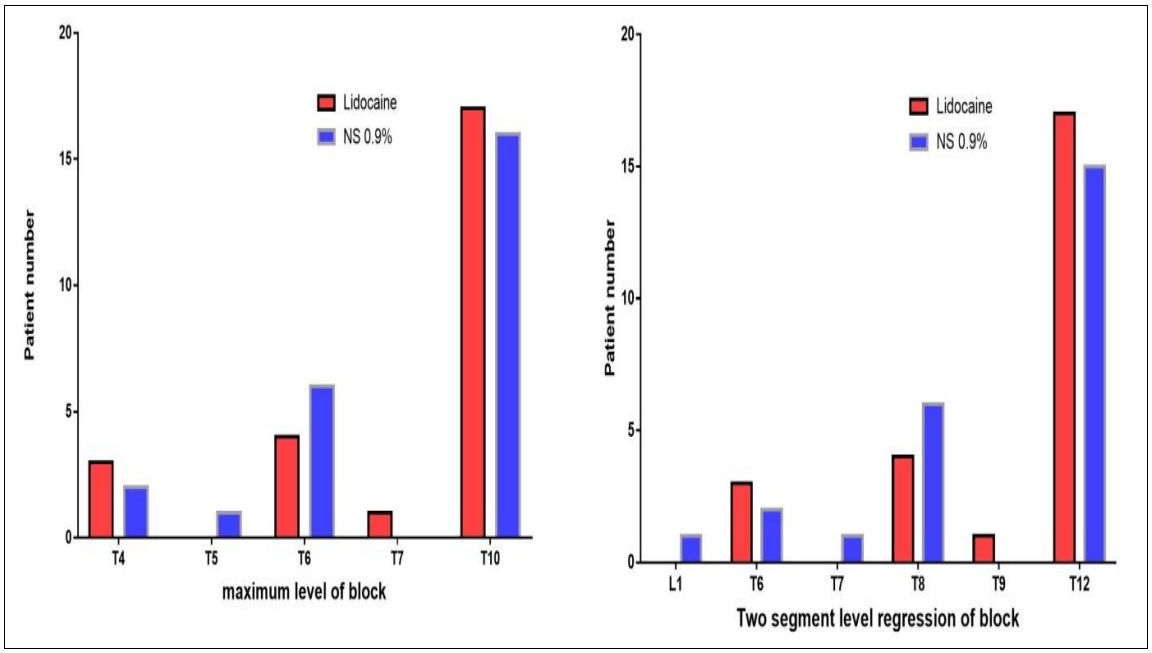

Fig 7: Maximum sensory level of block & two segment regression of block

There was significant difference in the distribution, in which Bromage score was higher in lidocaine group.

Table 4: Bromage score

Parameters	Groups		0	1	2	3
Bromage score	Lidocaine	No	0	1	9	15
		%	0.0%	4.0%	36.0%	60.0%
	NS 0.9%	No	5	0	9	11
		%	20.0%	0.0%	36.0%	44.0%
	P. value		-	-	1.0	0.433

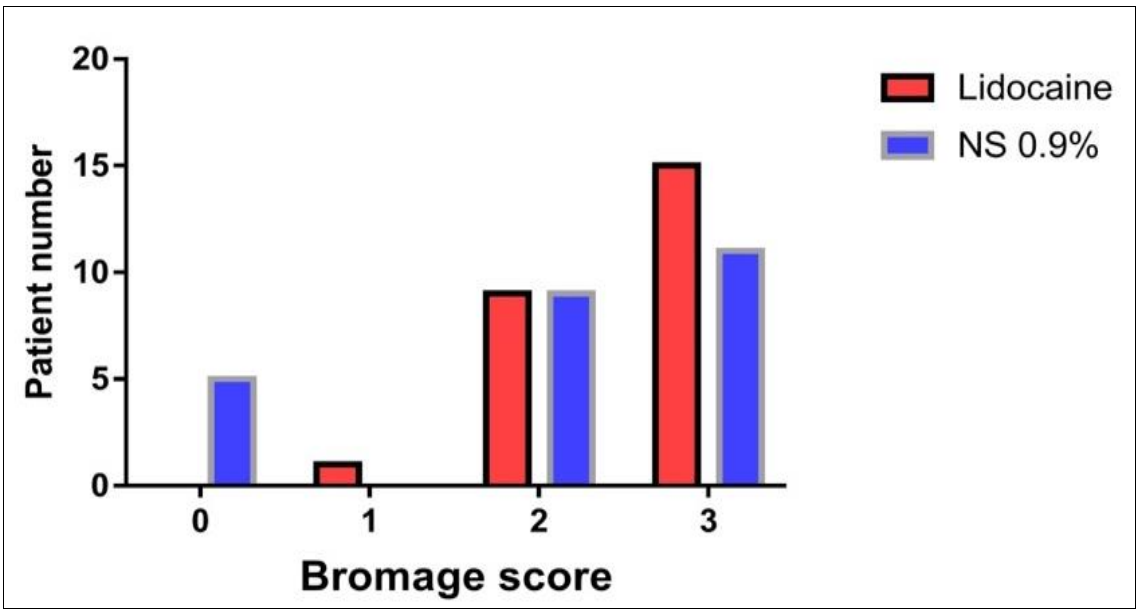

Fig 8: Bromage score

Discussion

Anesthesiologist gives epidural anesthesia for the lower limb amputation surgery, the epidural space usually determined by loss of resistance technique using either air or liquid such as saline or local anesthetics. Advantages of using air are easy identification of sticky syringe blunger, where as a liquid usually provide better proprioception. Previous studies reported slow onset and reduce quality of epidural anesthesia and analgesia when saline used instead of air for loss of resistance [6, 7].

Sanra *et al.* [8] reported that results were similar when air or liquid was used to identify the epidural space, but others found the use of liquid to be superior [9, 10].

This is first study shows a comparison between normal saline 0. 9% and lidocaine 2% without use of air alone or combined with liquid in detection of epidural space by using loss of resistance technique, where found lidocaine took less time for achieving sensory readiness (median of 8 min), while normal saline 0.9% need (18 min median time) to reach readiness. There were no significant differences either in the distribution of maximum sensory level or time of two segment regression of block in both groups.

In lidocaine group the distribution of motor blockade according to modified Bromage score started earlier than normal saline 0.9% group, but no significant difference in the maximum degree of motor blocked after achieving time of readiness and before surgery started.

A drawback of using lidocaine instead of N/S for detection of epidural space by loss of resistance is a possibility of converting an accidental Dural puncture into an actual subarachnoid block. This did not occur in our study, presumably because the fluid pushes the needle away from Dura, thereby minimizing risk of inadvertent Dural puncture.

In this study lidocaine was found to be superior on N/S in onset time of action and improve block quality.

Conclusions

1. The use of lidocaine 2% for detection of epidural space by using loss of resistance technique were found to be faster in achieving the desired sensory level of block in comparison with normal saline 0.9%.
2. The motor block was achieved earlier in lidocaine 2% group than those with normal saline 0.9% group.
3. There were no significant differences between the two groups concerning the hemodynamic stability.
4. There was no difference between the two groups in regression of block.

Recommendations

1. I recommend using lidocaine 2% to identify the epidural space by using loss of resistance technique that fasten the onset of action & do not produce any complications.
2. Further studies with larger numbers of patients and longer time of follow-up.

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Conflict of Interest: Nil

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