RESEARCH PAPER | Medical Science | Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

A Clinical Study of Brachial Plexus Block Using A Nerve Stimulator in Comparison With The Conventional Paraesthesia Technique

KEYWORDS: Brachial plexus, Paraesthesia, Nerve stimulator, Bupivacaine, Complications - Supraclavicular block, interscalene block, Axillary block.

*** Dr R KONDA REDDY**
Associate professor, Department of Anesthesiology, Kurnool Medical College, Kurnool, A.P.
* Corresponding Author

Dr P RAMA KRISHNA
Associate professor, Department of Anesthesiology, Kurnool Medical College, Kurnool, A.P.

ABSTRACT *Brachial plexus block quality is determined by accurate localization of nerves and precise injection of local anaesthetics into anatomical site. Eliciting paraesthesia with a needle has been the traditional mean of locating the brachial plexus. This study was to evaluate the safety and clinical efficacy of nerve stimulator by comparing with the paraesthesia method. This study was done in 50 ASA grade I and II patients, were randomly assigned into two groups. Group A, the block was performed by eliciting paraesthesia and group B by using nerve stimulator and observed heart rate(HR), blood pressure(BP), oxygen saturation (Spo2) and electrocardiogram in both groups. Success rate in group A 92% vs 84% in group B. The incidence of immediate complications were higher in group A (16%) vs 0% in group B. Time to initiate block was significantly lower in group A compared to group B. The volume of drug required and incidence of complications were lower in group B. So the use of nerve stimulator is equally efficacious block with lower volume of local anesthetic and significantly lower complication rate.*

INTRODUCTION

Brachial plexus block provides a useful alternative to general anaesthesia for upper limb surgeries. They achieve ideal operative conditions by providing superior analgesia, complete muscle relaxation, and stable haemodynamics. They also diminish postoperative nausea and vomiting.

The quality of block is determined by accurate localization of nerves and precise injection of local anaesthetic agent into anatomical site. Eliciting paraesthesia with a needle has been traditional mean of localizing the brachial plexus. Other nonparaesthesia techniques include cold saline stimulation, ultrasound guidance, CT guided techniques. Risks are nerve injuries 15%, are minimized by using short bevel needle, and ultrasound guidance.

Aims -

- To assess the clinical efficacy of nerve stimulator for brachial plexus localization
- To study the block characteristics using nerve stimulator and paraesthesia techniques.
- To compare the incidence of complications with both methods.

Methods - Inclusion criteria

1. Males and females in the age group of 15 to 65 years
2. Scheduled for upper limb surgery
3. ASA grade I and II

Exclusion criteria

1. Patient refusal
2. Shoulder surgeries
3. Patients of ASA grade III and IV
4. Patients with known local anaesthetics hypersensitivity
5. Patients with established peripheral neuropathy
6. Patients on anticoagulants
7. Pregnant and lactating mothers

STUDY:

The study comprises of 50 patients of both sexes in the age group of 15 to 65 years who are posted for upper limb surgeries. They were premeditated with tab. Diazepam 5 mg at night before surgery and injection midazolam 1 mg intravenously half an hour before the procedure. All vital parameters were recorded. Patients were divided into two groups. Group A paraesthesia and Group B nerve stimulator group. In both groups brachial plexus block was done by supraclavicular approach using modified Winne's method after infiltrating the skin with 2-3 ml of 1% lidocaine.

In group A 22G of 2" uninsulated needle used to elicit paraesthesia at arm, elbow and hand and injected 25 ml of 0.5% bupivacaine after negative aspiration of blood and air. In group B 22G of 2" insulated needle (stimuplex-B-Braun) used with nerve stimulator (Fisher&Paykel innervator 252).

The initial settings of nerve stimulator were 1 mA with pulse duration of 0.1 m sec and frequency of 2 Hz. The negative lead of the stimulator was connected to the needle. Observe the visible motor response flexion and extension of elbow, wrist or fingers. The current is decreased from 1 mA to smallest strength which gives visible motor response and then deposit 15 ml of 0.5% bupivacaine after negative aspiration for blood and air.

Parameters to be observed are time to initiate the block, onset of block, successful block, patchy block, failed block, duration of block, need for rescue analgesia, duration of surgery, tourniquet time, haemodynamic parameters, complications, and satisfaction of patient.

The statistical data were derived from Fischer exact test, Chi Square test, student T-test,(Two tailed, independent), significance figures (p values are $0.05 < P < 0.01$ suggestive; $0.01 < P \leq 0.05$ moderate significant, $P \leq 0.01$ strongly significant), statistical software was SPSS 15.0, stata 8.0, Med calc 9.0.1 and systat 11.0.

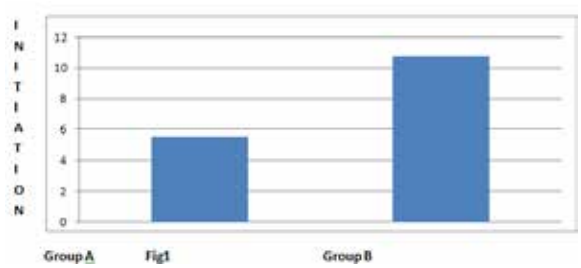
Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

Results:

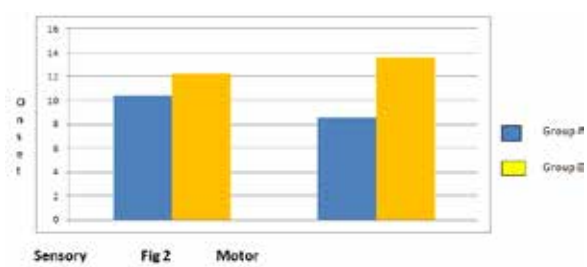
Table 1: Comparison of study variables in two groups of patients

Study variables	Group A	Group B	P value
Time initiation: Mean ± SD	5.5 ± 4.72	10.68 ± 5.68	0.001**
Onset: Mean ± SD			
Sensory onset	08.57 ± 5.62	13.61 ± 7.22	0.011*
Motor onset	10.38 ± 6.45	12.20 ± 7.29	0.369
Duration of			
Sensory block	07.52 ± 1.89	07.30 ± .84	0.751
Motor block	8.98 ± 2.43	08.20 ± .17	0.362
Failure of block: No (%)			
Complete	1 (4%)	2 (8%)	1.000
Patchy	1 (4%)	2 (8%)	1.000
Rescue analgesia: No (%)	2 (8%)	3 (12%)	1.000
Duration of surgery (min): Mean ± SD	101.40 ± 47.68	134.40 ± 45.92	0..018*
Tourniquet time: Mean ± SD	72.11 ± 22.61	114 ± 28.79	< 0.001**
Time to first request of analgesia: Mean ± SD	9.39 ± 1.85	8.83 ± 3.34	0.482
Patient satisfaction: No (%)			
Excellent	12 (48%)	11 (44%)	1.000
Satisfactory	11 (44%)	10 (40%)	1.000
Unsatisfactory	2 (8%)	4 (16%)	0667

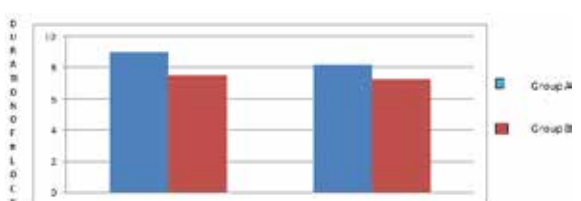
Time to initiate: It is earlier in group A than group B with mean ± SD of 5.54±4.72 and 10.68±5.68 minutes respectively with P value of 0.001 which is statistically significant.



Onset of block: also it is earlier in group A than group B with mean ± SD of 8.57±5.62 and 13.61±7.22 respectively with P value of 0.011 which is also being a statistically significant.

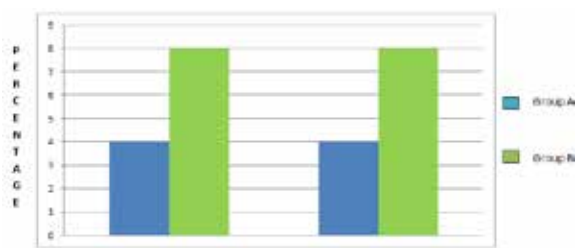


Duration of block: The duration of block was similar in both groups. The sensory block duration was 8.92±2.43 hours and 8.20±3.17 hours in group A and B respectively with P value of 0.362. But the duration of motor block was 7.52±1.89 hours in group A and 7.30±2.84 hours in group B with P value of 0.751.

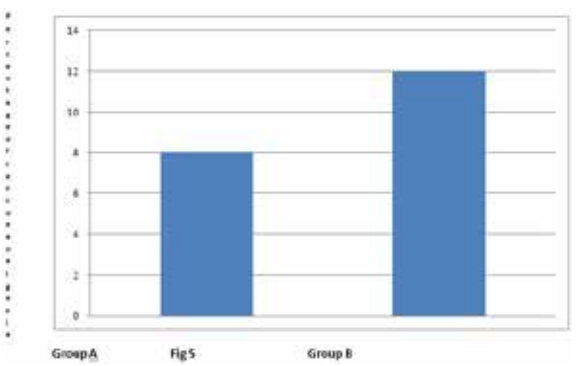


DURATION OF BLOCK Fig 3

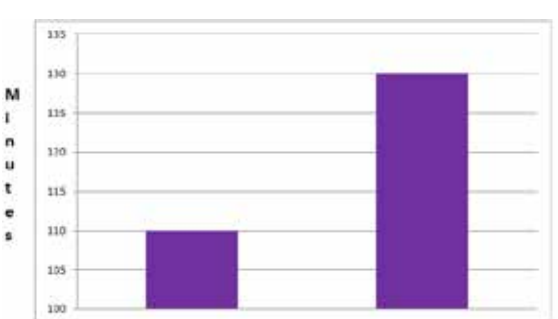
Failure rates: High failure rates observed in group B than group A with 8% and 4% respectively. Patchy blocks were 8% and 4% in group B and group A respectively, but results are not statistically significant with P value of 1.



Rescue analgesia: Group B patients requires rescue analgesia in 12% compared to 8% in group A patients, but results were not significant as P value of 1.

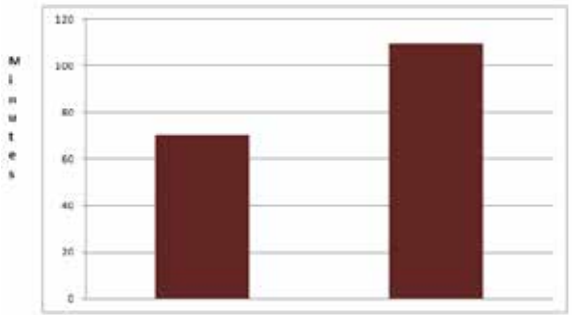


Duration of surgery and Tourniquet time: Both the duration and tourniquet time which were similar in both groups



DURATION OF SURGERY (MINUTES)

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X



Group A Fig 7 Group B
TOURNIQUET TIME (MINUTES)

Time at rescue analgesia: The time for rescue analgesia requirement was similar in both groups with Mean ± SD 9.39±1.85 hours in group A and 8.83±3.34 hours in group B and P value of 0.482.

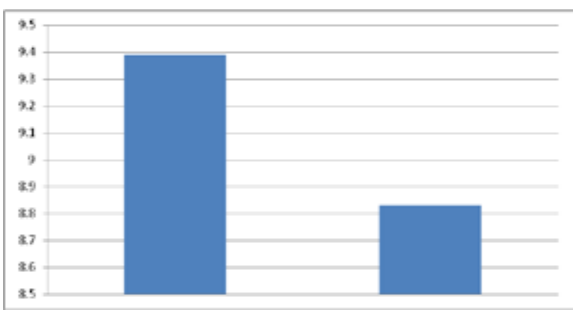
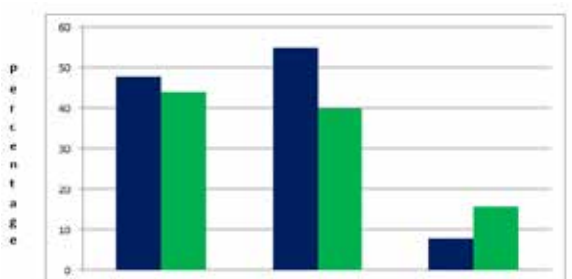


Fig 8

Patient satisfaction: -- patient satisfaction was almost similar in both groups with 48% patients in group A compared to 44% patients group B and had an excellent block at 55% and 40% respectively, unsatisfactory blocks were 8% and 16% in group A and group B respectively.

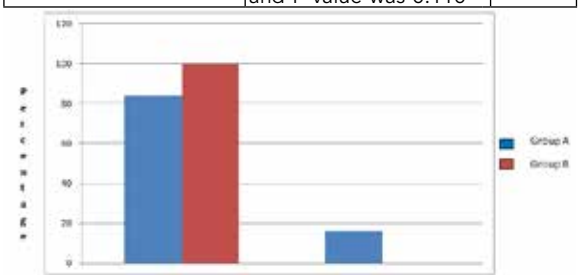


Excellent Satisfactory Unsatisfactory
Fig 9 PATIENT SATISFACTION

Complications: Complications incidences were more in group A (16%) and group B (0%). Vascular injury was 12% and none in group A and B respectively, this difference was statistically significant with P value of 0.11.

TABLE 2: COMPARISON OF COMPLICATIONS BETWEEN TWO GROUPS

Complications	Group A	Group B
Absent	21 (84%)	25 (00%)
Present	04 (16%)	0
Carpel spasm at tourniquet inflation which was limiting	01 (04%)	0
Vascular puncture	03 (12%)	0
inference	Incidence of complications statistically more in group A compared to group B (16% vs 0%) and P value was 0.110	

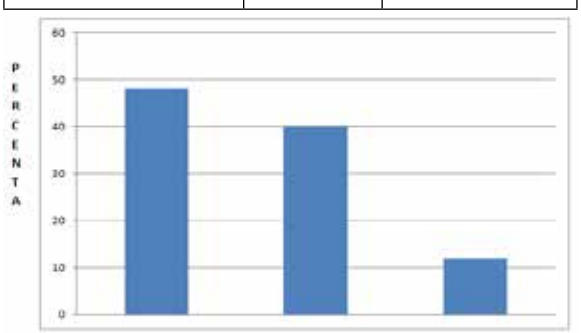


Absent Fig 10 Present
Complications

Strength of current: Mean current strength used in group B was mean±SD 0.69±0.21 mA, 48% patients require this output for nerve location, whereas 40% patients required 0.6-0.8 mA and 12% required more than 0.8 mA in group A patients.

TABLE 3

Strength of current	Number	Percentage
0.4-06	12	48
06-0.8	10	40
>0.8	03	12
Total	25	100
Mean ±SD	0.69±0.21	



0.4-0.6 0.6-0.8 Fig 11 > 0.8
Fig 11 STRENGTH OF CURRENT

Table 4 - Comparison of Pulse Rate between two groups

Pulse Rate	Group A	Group B	P Value
0 minute	82.08±11.42	79.84±11.88	t=0.5; p=05
5 minute	86.60±13.78	84.08±11.78	t=0.695; p=0.4
10 minutes	90.48±20.38	89.60±17.78	t=163; p=0.8
15 minutes	87.96±18.17	91.84±22.68	t=0.668; p=0.5
30 minutes	83.36±18.99	85.24±16.63	t=0.372; p=0.7
1 hour	74.72±07.88	83.52±17.87	t=2.253; p=09
2 hours	78.05±11.08	75.67±12.73	t=0.629; p=0.5
3 hours	78.00±04.00	73.20±09.87	t=0.802; p=0.4
4 hours	82.50±21.92	73.00±10.00	t=0.354; p=0.7

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

Table 5: Comparison of Systolic Blood Pressure between two groups

Systolic blood pressure	Group A	Group B	P Value
O minute	129.32±14.88	119.52±15.01	t=2.319; p=0.02
5 minutes	135..92±17.05	122.16±13.66	t=3.149; p=0.008
10 minutes	133.12±17.72	129.24±16.75	t=0.796; p=0.43
15 minutes	127.72±14.23	129.52±13.72	t=0.455; p=0.65
30 minutes	122.56±12.07	120.84±15.33	t=0.441; p=0.66
1 hour	118.48±07.42	122.16±10.32	t=1.448; p=0.15
2 hours	120.40±09.35	122.19±10.33	t=0.581; p=0.56
3 hours	127.67±17.90	114.90±17.87	t=1.058; p=0.36
4 hours	123.50±07.78	134.00±00.00	t=1.102; p=0.44

Table 6: Comparison of diastolic blood pressure between two groups

Diastolic Blood Pressure	Group A	Group B	P Value
0 minute	82.40±08.80	80.36±09.05	T=0.808; p=0.4
5 minutes	80.00±12.70	79.68±07.16	T=0.110; p=0.9
10 minutes	78.44±11.57	79.84±07.65	T=0.505; p=0.6
15 minutes	79.16±10.43	76.96±09.30	T=0.787; p=0.4
30 minutes	77.04±07.59	75.20±10.25	T=0.721; p=0.4
1 hour	74.20±08.63	75.72±08.57	T=0.625; p=0.5
2 hours	75.85±09.16	76.67±08.61	T=0.294; p=0.7
3 hours	76.00±04.00	79.90±05.51	T=1.125; p=0.2
4 hours	87.50±02.12	65.00±00.00	T=8.660; p=0.6

DISCUSSION:

In both groups supraclavicular approach (modified Winnie's method) was chosen for brachial plexus block, which does not involve the shoulder surgeries. It is associated with rapid onset, reliable anaesthesia and is proven to be a safe technique. The reason for success is injection done where the plexus is reduced to its few components and small size.

Dewees JL et al [1] compared interscalene block (ISB) to supraclavicular block (SCB) by using paraesthesia and find higher incidence of complete sensory and motor block with supraclavicular block and lower incidence of complications. Similar results were seen with Arcand et al [2] who compared infraclavicular block to supraclavicular block and by Kapral et al [3] who compared axillary block to supraclavicular block. Lanz E et al [4] showed that supraclavicular block results in more homogenous block compared interscalene block which causes preferential block of cephalad portions and axillary block which blocks caudal portions.

Baranowski et al [5] observed the positive correlation between numbers of paraesthesia sought and block success rate. The randomized control trials compared single to multiple paraesthesia and found no difference in the block efficacy [5, 6, 7].

By Yamamoto K et al [8], 222 patients study for axillary brachial plexus block showed the area of paraesthesia determined the sensory blockade. In Yasuda et al [9] study showed the distribution of paraesthesia was the success of the block constitutes 98% of ring, middle, and index fingers paraesthesia, but rare success rate when paraesthesia occurs in thumb or little finger. Urban MK et al [10] found proximal paraesthesia was as reliable as distal paraesthesia in brachial plexus block. In our study there was no correlation between area of paraesthesia and extent of block as in Raizada N et al [11] except in one patient where paraesthesia was elicited but block was failed.

Harshad G et al [12] study compared the > 0.5 mA and < 0.5 mA found that there was no significant difference in block success rate, concludes that there was no need of needle manipulations to achieve low stimulation thresholds as this may increase of risk of intraneural injection. In our study we used 0.4 mA to 1.2 mA and the mean was 0.69±0.21, but 0.4 to 0.6 mA was the commonest stimulation threshold in our patients.

Visible motor response as flexion or extension of elbow, wrist, or fingers as elicited by Gregory et al[13], Reigler FX[14] evaluated motor response characteristics at three sites of brachial plexus block with nerve stimulator shows strongest response in interscalene block at shoulder, elbow; supraclavicular block at elbow and fingers; axillary block at wrist and fingers. There was no association between response and success or failure of anaesthesia.

Franco CD et al [15] found that there was motor response of flexion or extension of fingers success rate was 86% and at wrist 12.3%. Serradell A et al [16] study comparing the different volumes of mepivacaine for axillary brachial block, the block efficacy and tolerance was similar using 36 mL, 28 mL, and 20 mL with added advantage of low systemic toxicity.

Fanelli G et al [17] calculated the mean effective volume of 0.5% bupivacaine required for axillary plexus block and interscalene and found it to be 25±5 and 20±10 mL respectively. Riazi et al [18] compared the efficacy of block using 20 mL and 15 mL of 0.5% bupivacaine and found no significant difference in the block quality with ultrasound guided interscalene block.

Use of 15 ml of 0.5% bupivacaine for nerve stimulation group with more emphasis on obtaining a good motor response, but adequate surgical anaesthesia could not be obtained despite paraesthesia elicited, so traditional volume of 25 mL has been described by various studies [13, 19].

OUR STUDY AND RESULTS:

Time to initiate: its mean time was 5.54±4.72 minutes and 10.68±5.68 minutes in group A and group B respectively. Sia et al [19] compared nerve stimulator and paraesthesia and time to block performance was 6±2 minutes and 9±3 minutes respectively. Gregory et al [13] reported block performance time of 5.0±2.7 minutes and 4.1±2.3 minutes in nerve stimulator group and paraesthesia group respectively. Dewees et al [1] reported block performance time 9.6±5.3 minutes using paraesthesia technique and Yasuda et al [9] have reported 13±1 minutes using nerve stimulator. Higher time required to initiate the block in group A is attributed to use of additional help required to operate the nerve stimulator.

Onset of block: it is seen that onset time in our study are as follows

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

Table 7

	Group A	Group B	P Value
Sensory	10.38±6.45	12.20±7.29	0.369
Motor	08.57±5.62	13.61±7.22	0.011

Sia et al [19] shown onset time of 21±5 minutes in paraesthesia group and 18±5 minutes in nerve stimulator group using 1% mepivacaine whereas in Yasuda et al [9] study, it was 21±1 minutes using bupivacaine with the nerve stimulator. Raizada et al [11] reported the sensory onset of time was 11.25±5.7 minutes and motor onset of time 14±1.4 minutes with paraesthesia with 0.5% bupivacaine. The significantly the shorter onset in group A suggests that the local anaesthetic is being deposited closer to nerve than nerve stimulator group [20]. The motor onset is earlier than sensory onset time in our study, also goes with concept of Winnie (motor nerves on the outer mantle of mixed nerve fibre). Very few patients shows motor nerve block occurred much later than sensory block, similar to Harshad G et al [12] explains the unequal distribution of motor and sensory nerves within nerve bundle.

Success and Failure rates: Horlocker et al [21] reported an increased success of paraesthesia (90%) over nerve stimulator, as do Mc Claine et al [22] (82% versus 75%) and Schroeder et al [23] (95% versus 88%), Gregory et al [13], Smith and Allison [24] reported higher success rate with nerve stimulator than paraesthesia technique during sciatic nerve blockade as does by Raj et al [25]. Very high success rates have been obtained by Vester-Andersen et al [26] (98%), Franco et al [27] (97%), and Tetzlaff et al [28] (94%). Franco and Veira et al [29] described successful perivascular subclavian brachial plexus block with nerve stimulator in 92.7%; Khan and Urquhart et al [30] reported lower success rates 67% with nerve stimulator for axillary brachial plexus block. The incidence of complete block was greater with nerve stimulator than paraesthesia by Sia et al [19] study (91% vs 76%). But in our study higher success rate with paraesthesia over nerve stimulator as 92% versus 84% respectively. Complete failure occurred in 8% with nerve stimulator and 4% with paraesthesia group. Patchy block occurred in 2 cases in nerve stimulator group. Incomplete block along radial side of forearm after 30 minutes, but adequate analgesia was obtained after giving injection fentanyl (60 µg), in one case was converted to general anaesthesia due to complete absence of sensory block on radial side despite adequate block of median and ulnar areas.

Duration of block and patients satisfaction: Duration of block was similar in both groups. Raizada et al [11] reported that the duration of sensory block was 515.9±138.4 and motor block duration was 338.4±101.8 by using 20 ml of 0.5% bupivacaine with paraesthesia technique. Patient's satisfaction was comparable in both groups.

Complications: Nerve injury occurs either due to surgical procedure or pathological conditions, direct injury, tourniquet injury, postoperative causes (splints, casts, and anticoagulants), high concentration of local anaesthetics, high volume of local anaesthetics, using neurotoxins, design of needle.

Selander et at [31] reported the nerve injury by design of needle tip, so he recommended the short bevel needles which produce low incidence of nerve injuries. Postanaesthetic nerve injuries occur in 2.8% in paraesthesia group, 0.8% in nonparaesthesia group as reported by Selander et al [32]. Similarly Plevak et al [33] found that persistent paraesthesia was 2.9% in nerve stimulator group and 0.8% in transarterial group. Fannelli et al [17] found only 1.7% neurological dysfunction in their study, Gentili et al [34] shown that paraesthesia will increase risk of nerve trauma, whereas Moore et al [35] disagrees the use of nerve stimulator will decrease incidence of nerve damage. Never continue the technique if patient complains pain, even though paraesthesia was elicited because of nerve injury as described by Barutell et al [36].

In our study neurological complications were higher in paraesthesia group compared to nerve stimulator group; 12 patients had vascular puncture, one patient developed carpel spasm (due to tourniquet), no immediate complications were noted in both groups.

SUMMARY

Since the introduction of regional anaesthesia, the brachial plexus blocks have been an integral part of an anaesthesiologist's clinical practice. Traditionally it has been performed using needle by eliciting paraesthesia along the brachial plexus distribution. The nerve stimulator was introduced to improve the safety of the technique as there was fear of needle trauma with paraesthesia technique.

Brachial plexus block was performed by supraclavicular approach by eliciting paraesthesia in group A using 25 ml of 0.5% bupivacaine. In group B 15 ml of 0.5% bupivacaine was used to perform supraclavicular block with a nerve stimulator. Time to initiate, onset and duration of block, failure rates, and complications were recorded.

CONCLUSIONS

Nerve stimulator provides equally efficacious blockade with similar onset and duration.

Location of plexus is easier with nerve stimulator but it takes longer setup time and infiltration time.

Nerve stimulator is useful tool for regional anaesthesia for beginners and trainees.

Lower volumes of drugs needed, will have less toxic potential.

Nerve stimulator method is safe as it had fewer incidences of complications.

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

REFERENCE

1 Dewees JL, Schultz CT, Wilkersen FK, Kelly JI, Beigner AR. A comparison of two approaches to brachial plexus anaesthesia for proximal upper extremity surgery: interscalene and intersternocleidomastoid AANA J 2006; 74:201-6 | 2 Arcand G, Williams SR, Chouinard P Ultrasound guided infraclavicular versus supraclavicular block. Anaesth& Analg 2005; 101:881-90 | 3 Kapral G, Kraft P, Eibenbrger K. Ultrasound guided supraclavicular approach for regional anaesthesia of brachial plexus. Anaesth &Analg 1994; 78:507-13. | 4 Lanz E, Theiss D, Jankovic D. The extent of blockade following various techniques of brachial plexus block. Anaesth & Analg 1983; 62:55-8. | 5 Baranowski AP, Pither CE. A comparison of three methods of axillary brachial plexus anaesthesia. Anaesthesia 1990; 45:362-65. | 6 Goldberg ME, Gregg C, Larijani GE. A comparison of three methods of axillary approach to brachial plexus blockade for upper extremity surgery. Anesthesiology 1987; 66:814-16. | 7 Abraham B, Zachariah M, Cherian M. Axillary brachial plexus block – A comparison of three techniques. JOACP 1995 Oct; 11(4):285-88. | 8 Yamamoto K, Tsuhokawa T. Area of paraesthesia as a determinant of sensory block in axillary brachial plexus block. Reg Anaesth Nov-Dec; 20(6): 493-7. | 9 Yasuda I, Hirano T, Ojima T . Supraclavicular brachial plexus block using a nerve stimulator and an insulated needle. BJA 1980; 52:409-11. | 10 Urban MK, Urquhart. Evaluation of brachial plexus anaesthesia for upper extremity surgery. Reg. Anaesth 1994 May-June; 19(3): 175-82. | 11 Raizada N. Does compounding and increase in concentration of local anaesthetic increase success rate of brachial plexus block? IJA 2002; 46(3): 193-96. | 12 Harshad G, Arjunan G, Giovanni C. The relationship between current intensity for nerve stimulation and success of peripheral blocks performed under general anaesthesia. Anaesth Analg 2007; 105: 1605-09. | 13 Gregory A L et al. Nerve localization techniques for interscalene brachial plexus blockade: A prospective randomized comparison of mechanical paraesthesia versus electrical stimulation Anaesth Analg 2006; 103:761-7. | 14 Reigler FX . Brachial plexus block with a nerve stimulator: a motor response characteristic at three sites. Reg Anaesth 1992 Sept- Oct; 17(5): 295-9. | 15 Franco CD, Feedor JG, Gennady V. Supraclavicular block in obese population: an analysis 2020 blocks. Anaesth Analg 2006; 102: 1252-4. | 16 Serradell A, Herrero R, Villanuevo JA. Comparison of three different volumes of mepivacaine in axillary plexus block using multiple nerve stimulation BJA 2003; 91(4):519-24 | 17 Fanelli G, Casati A, Garancini P, Torri G. Nerve stimulator and multiple injection technique for upper limb blockade. Failure rate, Patient acceptance, and neurological complications. A study group on regional anaesthesia. Anaesth Analg 1999; 88: 847-52. | 18 Riazi S, Carmicheal N, Awad I. Effect of local anaesthetic volume (20 vs 15 mL) on the efficacy and consequences of ultrasound guided interscalene block. BJA 2008; 101(4): 549-56. | 19 Salvator Sia, Maurizio B, Lepri A, Marchini O, Ponsecchi P. Comparative methods of nerve stimulator versus paraesthesia. Anaesth Analg 2000; 91:647-51. | 20 Perlas A, Niazi A, Mc Cartney C, Chan V, Xu D, Abbas S. Sensitivity of motor response to nerve stimulator and paraesthesia for nerve localization as evaluated by ultrasound. Regional Anaesthesia Pain Med 2006 Sep-Oct; 31(5): 445-50. | 21 Horlocker T, Kufner R, Bishop A. The risk of persistent paraesthesia in not increased with axillary block. Anaesth Analg 1999; 88:382-87. | 22Mc Claine D, Finucaine B, Interscalene approach to brachial plexus: Paraesthesia versus nerve stimulation. Reg Anaesth 1987; 12:80-3. | 23 Schroeder L, Horlocker T, Schroeder D. The efficacy of axillary block for surgical procedures above elbow. Anaesth Analg 1996; 83:747-51. | 24 Smith B, Allison A. Use of low power nerve stimulator during sciatic nerve block. Anaesthesia 1987; 42:296-98. | 25 Raj P, Montgomery S, Nettles D, Jenkins M. Interscalene brachial plexus block: a new approach. Anaesth Analg 1973; 52: 897-904. | 26 Vester - Andersen T, Christiansen C, Hansen A. Interscalene brachial plexus block: area of analgesia, complications, and blood concentrations of local anaesthetics. Acta Anaesth Scand 1981; 25:81-4. | 27Franco C D. The subclavian perivascular block. Reg Anaesth Pain Med. 1999; 3:212-16. | 28 Tetzlaff J, Yoon H, Brems J. Interscalene brachial block for shoulder surgery. Reg Anaesth 1994; 19:339-43. | 29 Franco CD, Veira ZE. Subclavian perivascular brachial plexus block success with a nerve stimulator. Regional Anaesthesia Pain Medicine. 2000 Jan-Feb; 25(1): 41-6. | 30 Khan R, Urquhart D. Transarterial technique is superior to nerve stimulator for axillary block (abstract) Reg Anaesth 1997; 21-2 | 31 Selander D, Dhuner KG, Lundberg G. Peripheral nerve injury due to injection needles used for regional anaesthesia. An experimental study of acute effects of needle point trauma. Acta Anaesthesiology Scavaninavia 1997; 21:182-88. | 32 Selander D. Axillary plexus block. Paraesthesia or Perivascular. Anaesthesiology 1980; 35:365-67. | 33 Plevak D, Lunstromberg J, Dameston B. Paraesthesia or Nonparaesthesia – the axillary block. Anaesthesiology 1983; 59:A216. | 34Gentili M, Wargnier J. Peripheral nerve damage and regional anaesthesia (Letter) BJA 1993; 70:594. | 35 Moore D, Murlroy M, Thompson G. Peripheral nerve damage and regional anaesthesia (Editorial) BJA 1994; 73:435-6. | 36 Barutell C, Vidal F, Raich M, Montero A. A neurological complication following Interscalene brachial plexus block. Anaesthesia 1980; 35:365-7 |