DOES COMPOUNDING AND INCREASE IN CONCENTRATION OF LOCAL ANAESTHETIC AGENTS INCREASE THE SUCCESS RATE OF BRACHIAL PLEXUS BLOCK?

Dr. Raizada N.¹ Dr. Chandralekha² Dr. Jain P. C.³ Dr. Kumar A.⁴

SUMMARY
Quality, onset and duration of sensory and motor blockade, haemodynamic effects and associated complications were investigated using different concentrations and combinations of lignocaine and bupivacaine, so as to identify the best concentration to be used in different surgical procedures without any toxic side effects. Blockade of supraclavicular brachial plexus block was done with a technique directed near the first rib, which is known to provide uniform and predictable anaesthesia for the upper extremity. 60 patients were randomly divided into three groups of 20 each. In group I, 30 ml of 1% lignocaine with 1:200000 adrenaline was used. In group II, a mixture of 10 ml of 1.5% lignocaine and 20 ml 0.25% bupivacaine and in group III, a mixture of 10 ml of 2% lignocaine and 20 ml of 0.5% bupivacaine was given.

7 patients had failed blockade and 18 patients required supplementation of the block in group I and II. Onset in group II and III was short as compared to group I. Duration of block was significantly more in group II and III than in group I. One patient each had coughing and chest pain during the block, five patients had arterial puncture and one patient experienced numbness of upper limb for 24 hours. Haemodynamic variables remained stable. No toxic side effect due to the drugs was observed. Compounding of lignocaine and bupivacaine provided the benefit of early onset and postoperative analgesia without the use of high volume of individual drug. Hence we conclude that 1% lignocaine with adrenaline was not suitable for conducting surgery under brachial plexus block. Mixture of 1.5% lignocaine and 0.25% bupivacaine provided good anaesthesia for short surgical procedures. However for long and emergency operative procedures, combination of 2% lignocaine and 0.5% bupivacaine was found to be the best.

Keywords: Supraclavicular nerve block, Lignocaine, Bupivacaine

Introduction
All the deep structures of the upper limb and the skin distal to the middle of the upper arm are rendered insensitive by blocking the brachial plexus. The nerves of the brachial plexus may be blocked anywhere along their course. Approach for blocking brachial plexus nerves are interscalene, supraclavicular, infraclavicular, axillary and subclavian perivascular approach¹.

Supraclavicular nerve block is technically easy to perform because of numerous reliable and fixed landmarks, but is usually avoided due to its association with the occurrence of pneumothorax¹-³.

The extent of blockade following injection into the sheath surrounding the brachial plexus may depend on the volume and concentration of local anaesthetic used⁴. The aims of our study are to observe the quality of sensory block, onset and duration of sensory and motor block, haemodynamic effects and any associated side effects by using different concentration of lignocaine, mixture of lignocaine and bupivacaine, so as to find out which combination is the best for different surgical procedures.

Material And Methods
Informed written consent from the patients and permission from the ethics committee was taken. 60 patients of ASA grade I-II undergoing either routine or emergency surgery for upper limb excluding shoulder were included in this randomised hospital based study.

Patients were divided into three groups of 20 each. In group I (n=20) 30 ml of 1% lignocaine with 1:200000

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adrenaline was used. In group II (n=20) a mixture of 10 ml of 1.5% lignocaine and 20 ml of 0.25% bupivacaine was administered. In group III (n=20) 10 ml of 2% lignocaine and 20 ml 0.5% bupivacaine was used. Preanaesthetic checkup of the patients was done. No premedication was used. Patients having difficult stature and in whom bony and muscular landmarks were not visible were excluded from the study.

Patient was positioned on the table with pillow under the shoulder. Part was painted and draped. A skin wheal was raised one cm above the mid clavicular point, which was midway between the sternoclavicular & acromio clavicular articulation. 20 gauge needle with 10 ml syringe filled with local anaesthetic agent was inserted through the skin wheal. The needle was then advanced gradually downwards, backwards and slightly medially, towards the first rib. In case the patient reported paraesthesia as instructed to him, the needle was fixed at that point. the aspiration test was done. to avoid intravascular injection of drug. The required volume of drug was injected at this point. If paraesthesia could not be elicited then the drug was injected on the first rib in fan shaped manner.

Quality of sensory block was assessed by pin prick using 22 gauge needle every 2 minutes upto 30 minutes and scored as 0=sharp, 1=dull, and 2=nosensation

Sensory testing was done in the regions supplied by the radial, median, ulnar, axillary, musculocutaneous nerve, medial cutaneous nerve of arm and forearm.A block was considered successful if the sensory score of 2 was observed in all the nerve regions except musculocutaneous nerve. The active movements of the hand and arm were sought for to assess the motor function. The regression of the block was similarly observed every 15 minutes till complete recovery.

Supplementation of anaesthesia if any was noted down along with the reasons for its administration. Pulse rate and noninvasive blood pressure were recorded preoperatively and immediately after giving the block and then every 10 minutes intraoperatively. Side effects and complications were also recorded.

### Results

Demographic data of patients and types of surgical procedures, which patients had undergone are shown in table I and II.

#### Table I: Demographic Data

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (years)</th>
<th>Weight (Kg)</th>
<th>Sex (M/F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>37.4±18</td>
<td>53.1±2.8</td>
<td>14/6</td>
</tr>
<tr>
<td>II</td>
<td>35.9±15.6</td>
<td>55.3±5.1</td>
<td>17/3</td>
</tr>
<tr>
<td>III</td>
<td>29.7±20</td>
<td>60.9±6.7</td>
<td>18/2</td>
</tr>
</tbody>
</table>

#### Table II : Types Of Surgical Procedures

<table>
<thead>
<tr>
<th>Surgical Procedures</th>
<th>Group I (n=20)</th>
<th>Group II (n=20)</th>
<th>Group III (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular Surgery</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Debridement</td>
<td>7</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Plating of Radius or Both</td>
<td>12</td>
<td>12</td>
<td>7</td>
</tr>
</tbody>
</table>

Seven patients required general anaesthesia. Out of these six patients were in group I and one patient in group II. Supplementation of brachial plexus block with injection pentazocine, diazepam and 66% nitrous oxide in oxygen was done in 18 patients that is 14 in group I and 4 cases in group II. However in group III no failure was observed (table III).

#### Table III : Sensory scoring in different groups

<table>
<thead>
<tr>
<th>Sensory score</th>
<th>Group I (n=20)</th>
<th>Group II (n=20)</th>
<th>Group III (n=20)</th>
<th>Total (n=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No %</td>
<td>No %</td>
<td>No %</td>
<td>No %</td>
</tr>
<tr>
<td>0</td>
<td>6</td>
<td>30</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
<td>70</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>75</td>
</tr>
</tbody>
</table>

0=Sharp 1=dull 2=nosensation

#### Table IV : Onset time and duration of block

<table>
<thead>
<tr>
<th>Type of block</th>
<th>Group I (n=20)</th>
<th>Group II (n=20)</th>
<th>Group III (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory</td>
<td>Onset (min)</td>
<td>Duration (min)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21.17±4.19</td>
<td>59.2±33.2</td>
<td>13.91±5.21</td>
</tr>
<tr>
<td>Motor</td>
<td>Onset (min)</td>
<td>Duration (min)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>Absent</td>
<td>19.97±6.0</td>
</tr>
</tbody>
</table>
The onset time and duration of sensory and motor block is shown in table IV. There was no significant difference between the onset time and duration of sensory block between group II and III. In group I, onset time for sensory block was significantly high and duration of sensory block significantly less as compared to the other two groups (p<0.05).

The onset time for motor block was significantly less and duration significantly higher in group III as compared to group II (p<0.05). No motor block was observed in group I.

One patient each in group II had incidence of coughing and chest pain at the time of giving the block. One patient in group III reported numbness of upper limb for 24 hours. 5 patients had arterial puncture.

No correlation was found between elicitation of paraesthesia and the quality of block. Out of 25 patients in which paraesthesia were elicited only 13 patients had complete anaesthesia while in rest 35 patients in which no paraesthesia were elicited 22 patients had sensory scoring of 2 (Table V).

<table>
<thead>
<tr>
<th>Elicitation of paraesthesia</th>
<th>Group I (n=20)</th>
<th>Group II (n=20)</th>
<th>Group III (n=20)</th>
<th>Total (n=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>3 5 1 2</td>
<td>1 3 5</td>
<td>8 25</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3 9 1 10</td>
<td>12 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6 14 1 15</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant change in heart rate or blood pressure was observed from baseline till 30 min after giving the block in all the three groups (Figure 1-2).

Discussion

The high failure rate was observed in group I (6 in 20) may be due to technical error in giving the block or due to prolong onset time for sensory block as we had taken cut off time of 30 minutes for our observations. The drawback of our study was that we did not use nerve stimulator in addition to anatomical landmarks for identifying the nerves because the instrument was not available in the operation theatres during emergency surgical procedures. However Baranowski and Pither5 in their study did not observe any difference in the success rate of nerve block by using either nerve stimulator or conventional techniques for nerve blockade.

The quality of anaesthesia was found to be excellent in group III as none of the patient required supplementation of the block. In group II the onset and duration of analgesia was almost similar to group III but 55% (11 in 20) patients required supplementation of the block with either nitrous oxide in oxygen or injection pentazocine and diazepam one hour after the start of surgical procedure. The number of patients indicated here are in addition to the other 4 patients in group II in whom supplementation of anaesthesia was done before the beginning of the surgical procedure.

According to Raj et al6 local anaesthetics when compounded act independently, as if they were used alone. This finding was confirmed by the fact that in group II and III onset time and duration of action were found to be similar. The short onset time may be due to the use of lignocaine and longer duration of action due to the use of bupivacaine. Although the intensity of block was more in group III, that is sensory scoring was equal to two in all the patients this can be explained due to the use of higher concentration of lignocaine and bupivacaine.
Complications had been discovered by most of the authors. Harley and Gjessing\textsuperscript{7} had arterial puncture as a complication in 33% of their cases. Brand and Papper\textsuperscript{2} observed haematoma in 2 out of 230 cases. In our study 5 patients had haematoma due to arterial puncture, which was compressed for 15 minutes immediately and resolved in 3-4 days.

The incidence of pneumothorax with the classical supraclavicular approach has been reported to be 0.5% - 6\%. However in our study only one patient had incidence of coughing which may be due to irritation of pleura by the needle. Although serial X-rays done did not show the signs of pneumothorax.

One patient in our study experienced chest pain during injection of the drug. This can be due to irritation of the nerve to serratus anterior as mentioned by Atkinson et al\textsuperscript{8}.

In group III, one patient had numbness of the upper limb for 24 hours. In this case tourniquet was applied for about three hours with a release of about 15 minutes in between. The probable cause seems to be the compression of nerves due to tourniquet rather than the drug or needle point trauma. No treatment was given and the patient recovered by himself.

In this study no toxic side effects due to the high dose of bupivacaine used in group III was observed. However in none of the patients, the maximum limit of the dose (2 mgkg\textsuperscript{-1}) was crossed\textsuperscript{1}.

There was significant increase in heart rate in group I, which may be due to epinephrine used with the local anaesthetic agent. Decrease in mean arterial pressure observed in groups II and III may be due to the depressant effect of lignocaine and bupivacaine on the myocardium and to the degree of sympathetic blockade following brachial plexus block. In addition to this sympathetic response of the patient is decreased due to the relief in pain after a successful block.

Thus concluding, the compounding of lignocaine and bupivacaine provided, the benefit of individual drug without the use of high volume of one drug alone. The short onset time was similar to lignocaine and hence shortened the waiting time for surgery. The duration of block with lignocaine bupivacaine mixture was longer as that of bupivacaine thus allowing long surgical procedures with added advantage of adequate postoperative analgesia. Our experience with 1% lignocaine with 1:200000 adrenaline was not good due to high failure rate and poor analgesia. The combination used in group II can however be used for short surgical procedures. The 100% success rate and excellent quality of block as observed in group III can be taken advantage for conducting long operations especially in emergency, where patients are full stomach and supplementation of the block with general anaesthesia is not desirable.

**Acknowledgement**

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**References**