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Epidural Anaesthesia in Elderly:A Comparison Of Ropivacaine With Bupivacaine

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Abstract: ***1.1 Introduction****Epidural anaesthesia is preferred in elderly. Amongst all local anaesthetics Ropivacaine is preferred in elderly due to its low cardiac and central nervous system toxicity.*
1.2 Aims and objectives*To compared efficacy of Ropivacaine 0.5% , 15ml with 0.5% Bupivacaine 15ml givenepidurally for lower limb surgery. We compared onset of sensory block, intensity of motor blockade, maximum level of anaesthesia achieved, time required for two segment regression, pulse rate and systolic blood pressure changes in both groups.*
1.3 Observation*Time required to achieve T10 sensory level was earlier Bupivacaine group than Ropivacaine group. Motor blockade inBupivacaine group was grade III (modified Bromage scale) in 29 patients and grade II in one patient. InRopivacaine group 01 patient had grade III, in 17 grade II, in 10 grade I while in 2 patients grade 0 motor blockade. Maximum sensory blockade achieved was T8 in both groups. In group R cardiovascular stability was better than group B. Time of onset of two segment regression was earlier in group R than in group B.*
1.4 Conclusion*It was concluded that sensory blockade is comparable in both Ropivacaine and Bupivacaine group. Ropivacaine provides less potent motor block with better cardiac stability when used in a concentration 0.5% .*
Key words *Bupivacaine, Elderly, Epidural anaesthesia, Ropivacaine*

I. Introduction

As a result of increased longevity number of elderly patients posted for surgery has been increased.Epidural anaesthesia is known to decrease intraoperative blood loss, perioperative cardiac ischemic events, post-operative hypoxic episodes and venous thrombosis.[1]It may be extended as postoperative analgesia and facilitate early ambulation.

A linear negative relationship between age and segmental dose requirement has been found in adults. It is due to decrease in size and compliance of epidural space in elderly. Aging affects the pharmacokinetics and pharmacodynamics of local anaesthetic.

Epidural Bupivacaine in elderly produces shorter onset, high sensory level of blockade and long duration of anaesthesia compared with younger volunteers[2]. Ropivacaine, a long-acting S(-)-enantiomer has less systemic toxicity as compared with Bupivacaine.[2,3] Low lipid solubility of Ropivacaine leads to blockade of Aδ and C fibres to a greater degree than Aβ fibre responsible for differential sensorymotor blockade.[4]

We compared efficacy of 0.5% Bupivacaine 15ml with 0.5% Ropivacaine 15ml given epidurally in elderly patients posted for lower limb surgery. We noted time required to achieve T_{10} sensory level, maximum sensory level achieved, quality of motor blockade, pulse rate, systolic blood pressure, and time required for two segment regression of sensory level and postoperative analgesia in both groups.

II. Aimsand objectives

This study was conducted in 60 elderly (AGE > 65years) patients posted for lower limb surgery. We compared efficacy of 0.5% Bupivacaine 15ml with 0.5% Ropivacaine 15ml given epidurally in elderly patients. We noted time required to achieve T_{10} sensory level, maximum sensory level achieved, quality of motor blockade, pulse rate, systolic blood pressure and time required for two segment regression of sensory level in both groups,

III. Material and method

We compared the efficacy of 0.5% Bupivacaine 15ml with 0.5% Ropivacaine 15ml given epidurally in elderly patients posted for lower limb surgery. We noted the time required to achieve T_{10}sensory level, maximum sensory level achieved, quality of motor blockade, pulse rate, systolic blood pressure and time required for two segment regression Of sensory level in both groups.

After approval of Medical Ethical Committee of the Hospital and obtaining informed consent, two groups of patients 30 each **(ASA** status 1 or **2)** scheduled for lower limb surgery were included in this study. . Patients were randomized in 2 groups by computer generated randomization with 30 patients in each Patient with history of adverse reaction to study medication, chronic pain syndrome and patients in which epidural anaesthesia was contraindicated were excluded from study.

After detail preoperative evaluation and investigations patients were posted for surgery. Intravenous infusion of *500* **ml** Ringers lactate solution was administered before the epidural injection. Thereafter, the infusion rate was maintained at a rate of 2 ml-'.kg-'.hour and blood transfusion was given if intraoperative blood loss was more than 20% of total blood volume. Intravenous Midazolam **1** mg was given as a premedication. Epidural anesthesia was given in sitting position with an 18 Gauge Toughyneedle. The epidural space was identified at L_2 -$L_{,3\ OR}$ L_3 -$L_{,4}$ space using loss of resistance technique under strict aseptic precautions and 18 Gauge epidural catheter was then advanced for 3 to 5cm into the epidural space. Correct placement of catheter was verified with a test dose of 3ml of 0.5% Lignocaine. Then patient received remaining 15ml of either drug. Group B patients received Inj. Bupivacaine while group R patients received Inj. Ropivacaineepidurally.

Sensory block was assessed by using response to pinprick with a short hypodermic needle. Time required to achieve $T_{10\ sensory}$ block was noted. Maximum level of sensory blockade was noted. Motor blockade was assessed by using modifiedBromage scale (o; no motor block; 1 – inability to raise extended legs, 2; inability to flex knees, 3; inability to flex ankle joints). Non- invasive arterial blood pressure, SPO_2 and continuous ECG were monitored. If the systolic blood pressure decreased more than **30%** or below 100 mm of Hg, ephedrine 5 mg was given intravenously. Maximum level of sensory block achieved and time required for two segment regression of sensory level was noted.

Data was analysed by Student's t tests and Chi square test. The data which included the hemodynamic parameters, SpO2, duration of analgesia were calculated and compared with baseline values within each group using the software 'Graphpad Prism5'.

Forcomparingquantitativedatabetweenthestudygroupsunpaired't'test wasapplied. Comparison of non-parametric (qualitative) data between the studygroups was doneusingChi-square test, Chi-square test for trendandFisherExact test depending on types of data. Statisticalsignificanceisindicated byconventionalsymbols: *P<0.05:Statisticallysignificant **P>0.05:Statisticallynon-significant

IV. Result

We compared effect of epidural administration of 15ml 0.5% bupivacaine with 15ml 0.5% Ropivacaine in elderly patients above the age 65. 60 patients were divided in two groups. Patients from group B received 15 ml of 0.5% Bupivacaine while patients from group R received 15ml of 0.5% Ropivacaineepiduraly for lower limb surgery.

Both the groups were comparable if age & sex were considered. Time required to achieve T10 sensory level was 8.75 +_ 2.41min. In group B and13.5 +_ 1.90mins. In group R with statistically significant P value < 0.0001. It indicates that onset of sensory blockade was earlier in group B than in group R. Maximum level of sensory blockade achieved in both groups was at $T_{8.}$

Motor blockade in group B was grade III in all patients except in one patient it was grade **II**. While in group R only one patient had grade IIImotor blockade, in 17 patients it was grade **II**, in 10 patients it was grade **I** while in 2 patients it was grade 0. It indicates that 0.5% Ropivacaine given in a dose of 15ml provides less intense motor blockade as compared to Bupivacaine.

Pulse Rate & Mean Arterial Pressurewas recorded every 5mins. Maximum changes in pulse rate and blood pressure were noted in first 30 minutes. In group B Pulse Rate was decreased from 82.27± 11.23 to 72.45± 11.48 while in group R was decreased from 88.10 ± 5, 89 to 87.60 ±10.58. It indicates that significant bradycardia was observed in group B than in group R. The P value was < 0.0001. Hence better cardiac stability was observed with Ropivacaine than Bupivacaine.

At the end of 30 minutes fall in systolic blood Pressure in group B was from 146.3±21 to 120.5±17.8 while in group R systolic blood Pressure was decreased from 150.00±16.99 to 145.5±16.99. It indicates more fall in systolic blood Pressure in group B than in group R. The P value was < 0.0001. Therefore better cardiac stability was observed with Ropivacaine than Bupivacaine.

Time of onset of two segment regression was 97.86±8.53 min in group B &78.25±5.13mins in group R with P value <0.0001. It was observed that Bupivacaine provides prolong anaesthesia than Ropivacaine.

Onset of analgesia was earlier in group B. Quality & extent of motor blockade was better in group B than in group R. Cardiovascular stability was good in group R than in group B. More bradycardia& fall in systolic blood was seen in group Two segment regression of sensory level was significantly earlier in group R than group B.

V. Discussion

The elderly population (≥65 years) is the fastest growing part of the population. Co-existing diseases and progressive decline in the functional capacity of organs make elderly patients vulnerable for per-operative complications[5].Neuraxial blockade is known to reduce mortality by one third along with reduced risk of deep vein thrombosis, pulmonary embolism, respiratory depression, myocardial infarction, and renal failure [6, 1]. With increasing age segmental dose reduction in epidural anaesthesia, has been documented. More cephalic spread of anaesthesia with shorter duration of sensory and motor blockade was observed in elderly patients[5]. While Wink J etal observed no effect on number of spinal segment blocked but increased caudad spread of analgesia with increasing age[7]. Extensive spread of local anaesthetic solution is attributed to arteriosclerosis and decreased leakage of local anaesthetic solution through intervertebral foramina.[8,9]As the fatty tissue degenerates with advancing age the epidural space becomes more compliant and less resistant which leads to the greater longitudinal spread of drug.[10]Also the changes inepidural connective tissue ground substance, epidural fat and epidural venous plexus velocity leads to change in local distribution of drug and affects its onset and offset time .[11,,12]Uptake into extra neural tissues, such as epidural fat, limits the rate and extent of drug distribution to the nerves and thereby changes the time profile of clinical potency.[13]

Decline in neural population, neural conduction velocity and interschwann cell distance in elderly is responsible for increased sensitivity of local anaesthetic drugs.[8]As hepatic blood flow declines with age, there may be decreased clearance of local anesthetics.[14]Considering all above factors rapid administration of large volume of local anaesthetic agent is not advised in elderly.[14] So we used both drugs in concentration of 0.5% and volume 15 ml each.

Ropivacaine is advantageous as it provides differential block with lower systemic toxicity.[15]Ropivacaine is a long-acting local anesthetic containing pure S (-)- enantiomer.Ropivacaine differs from Bupivacaine in the substitution of a propyl group for butyl group on piperidine rings tertiary nitrogen atom and it consists of a single (s)- enantiomer.[16]Neuronal and cardiac Na^+ channels action of the (s) – isomer of the piperidine containing local anaesthetic are less potent than the (R) isomer which makes Roipvacaine less potent than Bupivacaine .[16]Ropivacaine produces similar degree of anaesthesia with less motor blockade compared to Bupivacaine.[17, 18] Ropivacaine produced a slower onset, shorter duration and less intense motor block than the same concentration of bupivacaine.[18]

Small unmyelinated C fibres and small myelinated A fibres are responsible for pain transmission while large A fibres transmits motor impulse. Most local anaesthetics block C fibres at approximately same rate while rate of A fibre block depends on physicochemical properties of individual drug. High Pka and low lipid solubility favours blockade of C fibres before A fibres. Both drugs have comparable pkaRopivacaine 8.07 and that of Bupivacaine 8.1 and protein binding is 94% but ropivacaine is having low lipid solubility leading to lesser intensity of motor blocked.[7]

Ropivacaine blocks Aδ and C fibres to a greater degree than Aβ fibres which is responsible for differential block.[4,15] In-vitro study demonstrated that in equal doses, the depressant effect of bupivacaine on A-fibres was 16% greater than that of , Ropivacaine , but only 3% greater on C-fibers.[19]DusankaZaric observed that onset of motor blockade measured by the quantitative method was significantly slower with 0.5% Ropivacaine than with the higher concentrations of , Ropivacaine .[20]

In our study onset of analgesia was 13.55±1.90 minutes and less intense of motor blockade which might be due to use of 0.5% Ropivacaine in a dose of 15ml. Our results were same as that was observed by Brockway MS[18]who also noted less intense motor blockade with 0.5% ropivacaine compared with 0.5% bupivacaine. CASATI compared efficacy of 0.5% Ropivacain, Bupivacaine and Levobupivacaine used for epidural anaesthesia and found that in 40% patients in Ropivacaine group had motor block less than grade II(Bromage scale) while no patient from Bupivacaine group had motor block less than grade II (Bromage scale).[21]

Yuhong Li etal observed intense motor block and a higher upper level of analgesia in patients older than 61 years than in patients of 18–40 years[12] with the use of 20 ml ropivacaine . The result did not match with our study which might be due to use of 15ml Ropivacaine . An increase in concentration resulted in a profound motor blockade.[22] When 0.5% concentration was used, only one patient (20%) had greater than 1+ motor blockade. However, all of the patients receiving the 0.75% or 1.0% solution had at least 2+ motor blockades. These studies suggest that ropivacaineprovides satisfactory sensory anaesthesia with minimal motor blockade at a concentration of 0.5%.

The onset of sensory blockade was earlier with higher sensory level and longer duration in elderly than younger patients. High dose of Ropivacaine is needed to achieve sufficient analgesia for cesarean section or major abdominal surgery, than bupivacaine.[2]DusankaZaric observed that total duration of analgesia was significantly longer with 1% and 0.75% than with 0.5% Ropivacaine[2].

Olofsen,Erik etal noted that Ropivacaine had lower speed of onset and offset than Levobupivacaine.[14] This may be due to lower lipid solubility of Ropivacaine .[13] It was observed by Karz JA that , no significant

difference was found in motor or sensory effects with 0.5% Bupivacaine with 0.75% Ropivacaine given epidurally which proves their equipotency at different concentrations[23].This might be the reason for our observations suggesting less potency of Ropivacaine than Bupivacaine.

P-A.Nydahl, observed that, the motor blockade in the lower extremities was about 1.5 hours shorter in duration in elderly than in young adults.[24] This might be due to high pka and low lipid solubility of Ropivacaine which blocks Aδ and C fibres to a greater degree than Aβ fibres[19] and the local anesthetic had access to a greater absorptive surface in the epidural space, as indicated by a wider spread of analgesia associated with a greater uptake.A more limited longitudinal distribution of local anesthetic within the epidural space, as in young persons, should give a greater mass of local anesthetic per unit nerve tissue, resulting in a more intense motor blockade[24]

Geriatric patients have decreased beta-adrenergic responsiveness and an increased incidence of conduction abnormalities, bradyarrythmias and hypertension.[5] In the non-compliant older heart, small changes in venous return will produce large changes in ventricular preload and cardiac output. Due to diastolic dysfunction and decreased vascular compliance, the elderly patient compensates poorly for hypovolemic. Similarly, exaggerated transfusion is also poorly tolerated.[5]It is therefore important to consider fluid administration carefully.[5]

Cardiovascular toxicity of local anaesthetic drug involves direct effect on myocardium, on vascular tissue and innervation of heart.[16] Low lipid solubility of Ropivacaine is responsible for lower cardiovascular toxicity than bupivacaine. Following intravascular administration ropivacaine has 25% less central nervous and cardio toxicity than bupivacaine.[25]

In a study comparing the isomers of bupivacaine and ropivacaine, it was shown that in equal doses, both isomers of bupivacaine prolong AV conduction time significantly.[26] Although both drugs caused evidence of depression of conductivity and contractility, these appeared at lower dosage and lower plasma concentrations with bupivacaine than with ropivacaine.[27] Very slow reversal of Na channel blockade after cardiac action potential is seen with Bupivacaine while it is faster with Ropivacaine so it supports greater therapeutic index for Ropivacaine than Bupivacaine regarding cardiovascular toxicity. Intravascular Ropivacaine is cleared more rapidly from circulation than Bupivacaine. [16]

We also noted good cardiovascular stability with Ropivacaine than Bupivacaine.

The drawback of our study is use of low concentration and dose of Ropivacine and further study with higher concentration is needed. It can be concluded that Ropivacaineis less potent than Bupivacaine. But less potential for cardio toxicity makes Ropivacaine a good choice in elderly.

VI. Conclusion

It was concluded that sensory blockade is comparable in both Ropivacaine and Bupivacaine group. Ropivacaine provides less potent motor block with better cardiac stability. So it can be a good choice in lower limb surgery in elderly patients. For better motor blockade further study is required with concentration greater than 0.5% .

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1. Observations

1.1 Table 1

	Group B (mean + SD)	Group R (mean + SD)	P value
Age	65.91+3.16	64.48+2.42	0.1039
Sex	20:10	23:07	

There was no statistically significant difference in either group. Age was comparable in both groups.

1.2 Table II

	Group B (mean + SD)	Group R (mean + SD)	P value
Time required to achieve T10 sensory level	8.73+2.41	13.55+1.90	<0.0001

There is statistically significant difference in time required to achieve t10 sensory level in both groups. Onset of analgesiais earlierin Group B than in Group R.

1.3 Table III

Grade of motor blockade	Group B (mean + SD)	Group R (mean + SD)
Gread 0	00	02
Gread I	00	10
Gread II	09	17
Gread III	21	01

Motor blockade is more intense in group b than in group r

1.4Table IV

	Group B (mean + SD)	Group R (mean + SD)	P value
Time required for two segment regression of sensory level	97.86+8.53	78.25+5.13	<0.0001

There was statistically significant difference in time required for two segment regression of sensory level in both groups.
Two segment regression of sensory level was earlier in group B than in group R.

1.5 Table V

Pulse rate changes	Group B (mean + SD)	Group R (mean + SD)	P value
Preoperative	82.27+11.23	88.11+5.89	0.0446
At 30 minutes.	72.45+11.48	87.60+10.58	<0.0001

There is statistically significant difference in pulse rate after 30 minutes of epidural drug administration in both groups.

Bradycardia is observed in group b compared to group r , suggesting good cardiovascular stability in group r

1.6 TABLE VI

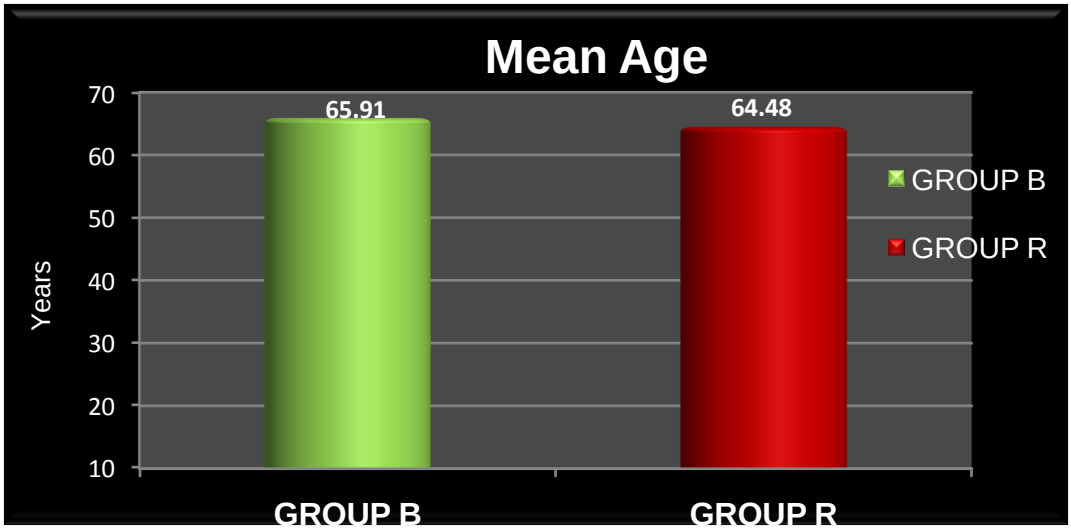
Systolic blood pressure changes	Group B (mean + SD)	Group R (mean + SD)	p value
Preoperative	146.3+21	150_+16.99	0.522
At 30 minutes.	120.5+19.89	145.5+16.99	<0.0001

There was statistically significant difference in systolic blood pressure after 30 minutes of epidural drug administration in both groups.

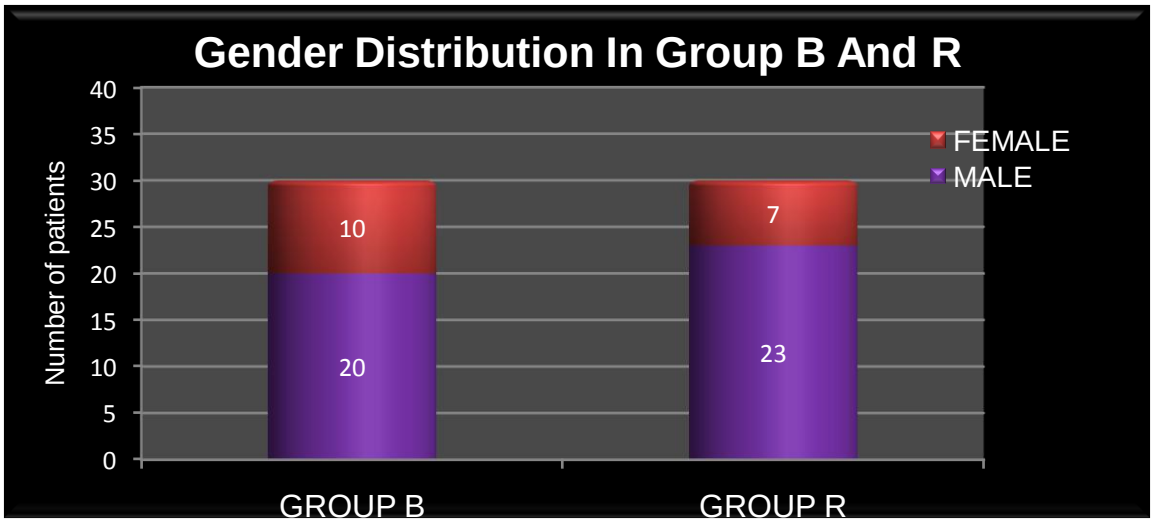
Hypotension was observed in Group B compared to Group R, suggesting good cardiovascular stability in Group R

2 Graphs

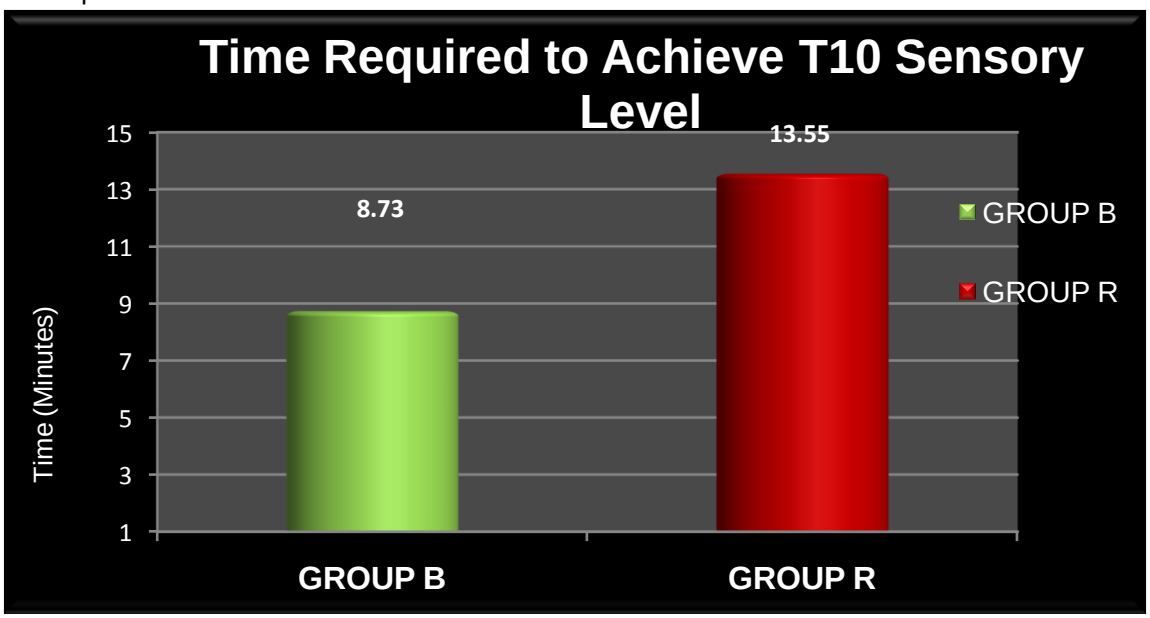
2.1 Graph I



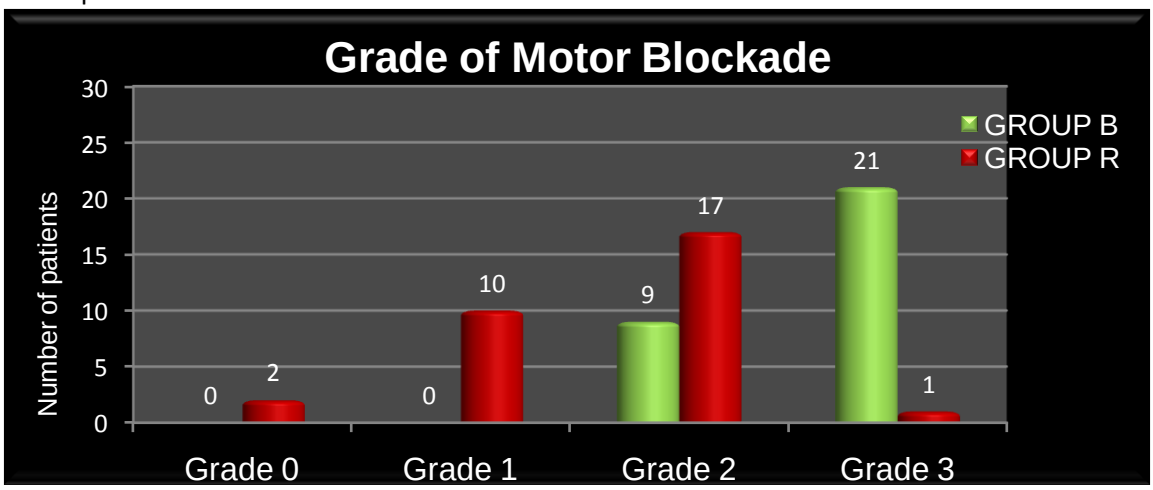
2.2 Graph II



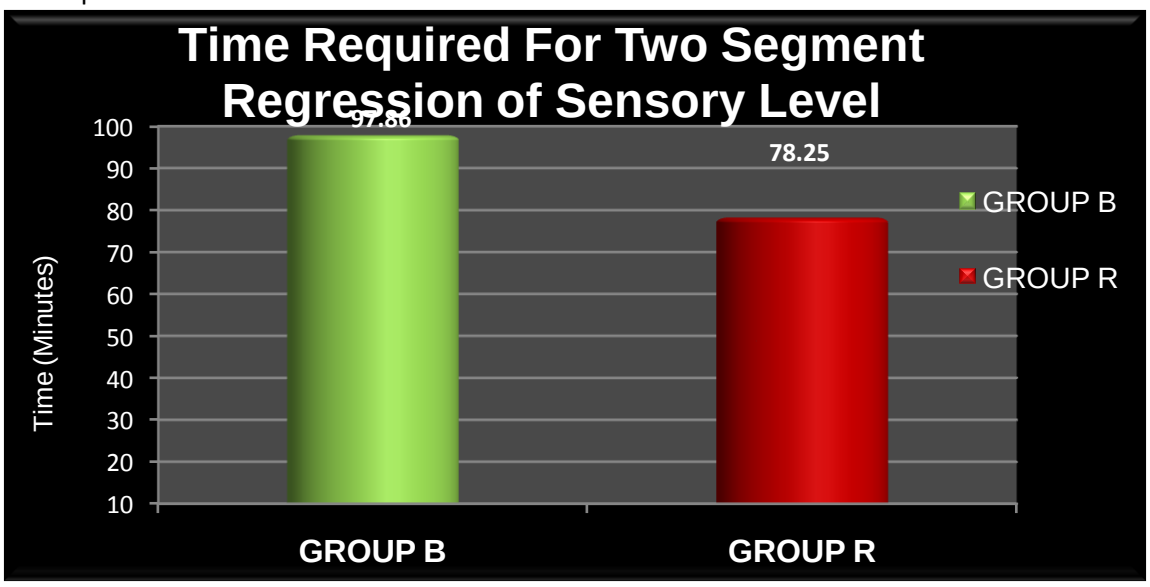
2.3 Graph III



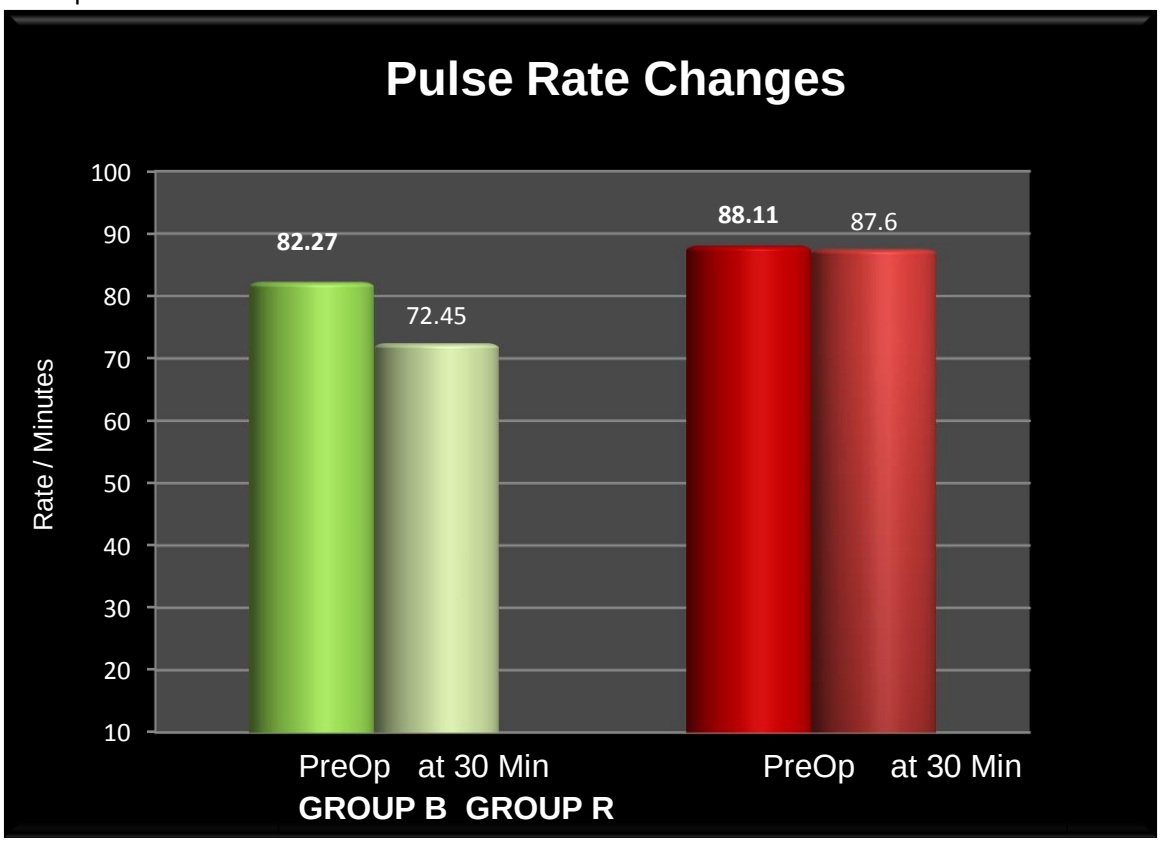
2.4 Graph IV



2.5 Graph V



2.6Graph VI



2.7 Graph VII