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RESEARCH ARTICLE

MGSO4 AND DEXMEDETOMIDINE AS ADJUVANTS TO LOCAL ANAESTHETICS IN BRACHIAL PLEXUS BLOCK (USG GUIDED) FOR UPPER LIMB SURGERY: A COMPARATIVE EVALUATION

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Abstract

Background: Peripheral nerve block has become quite popular in outpatient and inpatient anaesthesia for upper limb procedures due to its safety and unmatched success rate. Supplementing local anaesthetics with adjuvants extends the postoperative time as well as providing intraoperative care. The objective is to assess the effectiveness of bupivacaine and MgSO4 as adjuvants in the supraclavicular brachial plexus block.

Methods and Results: 60 Patients were arbitrarily split into two equal groups. 20 mL of 0.5% Bupivacaine with 1 mL of Dexmedetomidine (100 g) were injected into Group D (n = 30),) and 20 mL of 0.5% Bupivacaine with 1 mL of MgSO4 (250 mg) were injected into Group M (n = 30). Hemodynamic parameters, sedation score, analgesia onset and duration, and satisfaction scores were all chronicled. The onset of sensory block was faster in Group D (5.43 ± 0.48 min) than in Group M (7.09 ± 0.14 min). The time of onset of motor block was faster in Group D (8.14 ± 0.56 min) than in Group M (10.87 ± 0.71 min) The duration of analgesia was again higher in Group D (1012.2 ± 24.15min) than in Group M (607.4±11.72 min).

Conclusions: When compared to patients receiving MgSO4, patients receiving dexmedetomidine have sensory and motor blocks that begin earlier, endure longer, and have smaller postoperative rescue analgesia requirements. With dexmedetomidine, there is a greater frequency but non-significant incidences of hypotension, bradycardia, and better sedation score.

Introduction:-

Regardless of developments in perioperative care, orthopaedic operations are still followed by postoperative pain that is strong and hard to control. Regional anaesthesia has numerous advantages, including reduced hemodynamic unsteadiness, evasion of airway instrumentation, and intra-operative and postoperative analgesia.[1]

Peripheral nerve block offers intraoperative anaesthesia and expands analgesia in the postoperative phase without chief systemic side effects by minimising stress retort and utilising negligible anaesthetic drugs.[1,2] Upper limb surgeries are frequently performed under peripheral nerve blocks such as the brachial plexus block.[3] Brachial plexus blockade for upper limb surgery is beneficial as the outcome of the drug is limited to the part of the body to

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be operated upon. It is devoid of complications linked with general anaesthesia. Moreover, it offers premature oral feeding and ambulation thereby dipping postoperative complications.

The issue is to extend analgesia's duration while minimising its adverse impacts because brachial plexus blocking only briefly relieves pain. With different degrees of effectiveness, a range of perineural adjuvants [1,4] has been tested to shorten the commencement and lengthen the span of analgesia.

The amide local anaesthetic bupivacaine, which is generally employed to block the brachial plexus, has an effect time of from three to six hours, which may not be long enough to provide adequate pain relief following surgery. In order to extend its effects, numerous supplements have been utilised[5]. These include dexmedetomidine [5-8] and (clonidine) as well as epinephrine, midazolam, MgSO4 and alpha-2 agonists like epinephrine. NMDA receptor antagonist properties of magnesium, a physiological calcium channel blocker, limit central sensitization by peripheral nociceptive stimulation and are employed to extend the duration of the block. This research compared the effectiveness of magnesium sulphate and dexmedetomidine when used as an adjuvant to 0.5% bupivacaine in supraclavicular brachial plexus block in terms of the period of analgesia, commencement and duration of sensory and motor block.

Methodology:-

After receiving an endorsement from the institutional ethical committee, this prospective, randomised, double-blinded study was executed from October 2022 to June 2023 at the LG Hospital of the Narendra Modi Medical College. Patients enrolled for upper limb surgery who were of ASA physical status I and II, and between the ages of 19 and 60 were included with informed written permission. There was a pre-anaesthesia examination and patients with coagulopathies, localised infections, cancer, dementia or disorientation, hypersensitivity or allergies, and other conditions were dropped from the research study.

During the preoperative visit, all patients underwent clinical examinations, routine investigations were reviewed, and the entire procedure was talked about as well. During the preoperative appointment, the 10 cm visual analogue scale (VAS), which ranges from zero to the worst pain possible, ten, was also described. [9] Assessments of the Visual Analogue Scale were planned to be conducted every 30 min for the first two hours, then hourly for the following six hours, and finally every four hours for the following twenty-four hours. Rescue analgesia in the form of Diclofenac sodium 75 mg intravenous increments was administered as needed when the patient complained of pain measuring VAS score ≥4. Each patient received a certain dosage (total analgesic requirement)of Diclofenac sodium throughout the course of the first 24 hours following surgery which was noted too. The time for the first request for the analgesic requirement was noted as well.

Using computer-generated code, a total of 60 patients were chosen and randomly divided into two research groups of 30 patients each. The sample size calculation was based on the 95% confidence interval and 5% alpha error.

1. In Group B D (n = 30) 20 mL of 0.5% Bupivacaine with 1 mL of Dexmedetomidine (100 g) was administered.
2. In Group B M (n=30) 20 mL of 0.5% Bupivacaine with 1 mL of MgSO4 (250 mg) was administered.

Before the procedure, all patients were required to fast for a minimum of 6 hours.

In all, each group received 21 mL of the study drug. Standard monitors including ECG, NIBP and pulse oximetry were attached and parameters were recorded in the operating room. In the unaffected limb, an IV line with an 18 G cannula was affixed and a 5 mL/kg crystalloid infusion was commenced.

The in-plane approach with a 6-13 MHz linear US probe (Sonosite M-Turbo) put in a sterile sheath was used to deliver ultrasound-guided single-injection supraclavicular blocks after locating the brachial plexus trunks and/or divisions over the first rib, lateral to the subclavian artery.The patient lay supine with the head facing to the opposite side of the supraclavicular block. Following skin infiltration with 1 mL of 1% lidocaine, a sterile 23-gauge 1.5-inch needle was then advanced to the junction of the first rib and subclavian artery. The perineural solution was injected in 5-mL small amounts after negative aspiration to ensure unfurl in the corner pocket plexus sheath under screen vision.

The pinprick technique was used to grade the Sensory Block (SB).[9]
2 = Complete block (loss of touch sensitivity/no sensation),

1 = Partial block (loss of feeling to pinprick/decreased sensibility),
0 = No block (normal experience).

Sensory Onset:
The time interval from the injection of the study drug till the complete sensory block (SB=2) **Duration of sensory block**: SB (2) to SB(0) **Duration of analgesia**: the time interval between the onset of the complete SB (SB=2) till when VAS (Visual Analog Scale) was ≥4.

The Bromage three-point score .[10]was used to evaluate the Motor Block (MB):
Score 0: normal motor function with full elbow, wrist, and finger flexion and extension,
Score 1: decreased motor strength with just finger movement possible, and
Score 2: total motor blockage with no finger movement.

The onset of MB: time from the injection study drug till score 2 achieved

Duration of MB: The time from the onset of MB until its full resolution.

When complete sensory and motor block was attained within 30 minutes of the study drug's injection, the block was deemed effective, and those with insufficient blocks were disqualified from the research.

Sedation was assessed employing the Ramsay sedation score (RSS) .[11]
1 = stressed, agitated, and restless,
2 = cooperative, oriented, and tranquil,
3 = responsive to commands only,
4 = asleep but has a brisk response to a light glabellar tap or loud auditory stimulus,
5 = sluggish response to a light glabellar tap or loud auditory stimulus, and
6 = no response to a light glabellar tap or loud auditory stimulus.

At the conclusion of the procedure, the efficacy of the anaesthesia.[11] was rated as follows:
excellent (4) = no complaints from the patient;
good (3) = minor complaints;
(2) = moderate complaints requiring additional analgesics; unsuccessful
(1) = General anaesthesia was required.

Complications during and after surgery were evaluated in patients. Atropine 0.6 mg i.v. injection was used to treat intraoperative bradycardia (50 beats/min) and mephentermine 6 mg injection was used to treat hypotension (>20% below baseline value).

Statistical Analysis
The mean (±) as well as the standard deviation were used to represent all the data. The student's unpaired t-test was used to compare quantitative data, while the student's paired t-test was used to examine qualitative data. Continuous variables were compared between the two groups using the Statistical Package for Social Sciences (SPSS, IBM version 22.0). P 0.05 was deemed statistically significant.

Results:-

The research involved 60 participants. In terms of demographic characteristics, anthropometric measurements, duration of operation, and ASA physical status, it was determined that all the groups were equivalent.

The onset of sensory block was faster in Group D (5.43 ± 0.48 min) than in Group M (7.09 ± 0.14 min). The time of onset of motor block was faster in Group D (8.14 ± 0.56 min) than in Group M (10.87 ± 0.71 min). The duration of the sensory block was higher in Group D (905.90 ± 17.48 min) than in Group M (512.66 ± 37 min). Similarly, the duration of the motor block was also higher in Group D (814.74 ± 4.98 min) than in Group M (524.52±9.99 min. The duration of analgesia was again higher in Group D (1012.2 ± 24.15min) than in Group M (607.4±11.72 min) . The difference in terms of onset and duration of sensory and motor, duration of analgesia between the two groups was highly statistically significant. The total amount of injection diclofenac sodium used in Group D (211.66±8.31 mg) and 281.4±12.54 mg in Group M as shown in Table -2

The quality of the block in Group D was excellent in 86.66% and good in 13.33% of patients butin Group B, the quality was excellent in 60% of patients and good in 40% of patients. Which was statistically significant depicted in Table 3

In our study, the VAS score was nil for all the patients until 5 hours. It was less than 4 until 12 hours in Group D whereas it became 4 at 10 hrs in Group M and rescue analgesia was given. Rescue analgesia was given at 16 hours in group D. (Figure 1)

Group D reported higher sedation scores compared to Group C. ANOVA showed that there was a significant difference in RSS among the groups at 60 min (P = 0.001), 90 min (P = 0.03), and 120 min (P = 0.01) (Figure 2). 3.3% of patients had skin rash which subsided on its own in Group D. 10% of patients had nausea in Group D where as 3.3 % in Group M experienced Nausea. 13.3% had Bradycardia along with hypotension which was treated with an Injection of Atropine 0.6 mg IV in Group D.

Discussion:-

With a 2:1 binding selectivity ratio of 1620:1, dexmedetomidine, the pharmacologically active d-isomer of medetomidine, is a highly specific and selective alpha 2 adrenoceptor agonist that eliminates the side effects of alpha 1 receptors[(12,13)] has sedative, analgesic, sympatholytic and cardiovascular stabilizing effects .[(14)]

With regard to magnesium sulphate's antagonistic impact on NMDA receptors, which are involved in central nociceptive transmission, itmay have analgesic effects. MgSO4 has the ability to control calcium influx in cells and prevents neurotransmitters from being released at synaptic clefts, which potentiates the effects of local anaesthetics[(15)]. The surface charge theory, which contends that altering the external magnesium concentration produces a synergistic impact on nerve blockade with local anaesthetic[(16)]also explains its efficacy as an adjuvant.

Dexemiditomidine and magnesium sulphate have been individually used as an adjuvant to bupivacainebut none has been used in comparison so we planned to compare both agents. The use of ultrasound gave us the advantage of real-time monitoring of drug injections around the plexus.

Nemaetal.[.[(17)]carried out an ongoing allocated double-blind study for 60 patients and observed that the time of onset of sensory block was swifter in the group receiving dexmedetomidine (7.20 ± 2.483 min) as contrasted with the group receiving placebo ie control group (14.20 ± 5.229 min) and also the time of start of motor block was earlier in dexmedetomidine group (11.83 ± 3.824 min) as juxtaposed to the control group (21.00 ± 8.566 min) which is in alignment to our study. Several studies among them those by Bharti et al.[(18)]Kathuria et al.[(19)]and Das et al. [(20)], provide strengthenedfindings of our study. In all of these studies, it was shown that adding dexmedetomidine to ropivacaine in the supraclavicular block accelerated the onset of sensory and motor block.

According to Shukla et al. [(11)], the addition of dexmedetomidine or MgSO4 to ropivacaine caused sensory and motor blocks to start developing earlier and last longer. Group B (dexmedetomidine) and Group C (MgSO4) both had the faster onset of sensory and motor block, while Group A experienced the slowest onset. Group A had the shortest sensory and motor block duration, whereas Group C had the longer and Group B had the longest duration.

Mukherjee et al. [(6)]observed that the addition of MgSO4 increases the onset time of sensory and motor block. Similar findings were also seen in a study conducted by Malleeswaranet al.[[(21)]and Ekmekci et al. [(22)] In our study, we observed that the addition of dexmedetomidine or MgSO4 to ropivacaine resulted in prolonged duration of analgesia postoperatively.

The duration of analgesia was minimum for Group A, followed by Group C and maximum for Group B. In a randomized double-blind controlled study conducted by Chinnappa et al. [(23)] they found that the addition of dexmedetomidine to ropivacaine for supraclavicular block prolongs the duration of sensory and motor block in the dexmedetomidine group (630.6 ± 208.2 and 545.9 ± 224.0 min) than ropivacaine group (400.8 ± 86.6 and 346.9 ± 76.9 min) and the period of analgesia was smaller in ropivacaine group (411.0 ± 91.2 min) then dexmedetomidine group (805.7 ± 205.9 min) which is similar to the study by Shukla et al. [(11)]where The duration of sensory block was maximum for Group B (917.40 ± 103.17 min), followed by Group C (584.50 ± 71.57 min), the minimum for Group A (339.75 ± 30.67 min). similarly,the duration of the motor block was maximum for Group B (827.55 ± 86.81 min), followed by Group C (543.30 ± 69.01 min) and minimum for Group A (282.25 ± 23.97 min).

According to Mukherjee et al. [6], the magnesium group (RM) required fewer rescue analgesics overall. According to Bharti et al. [18], the dexmedetomidine group required less rescue analgesia within the first 24 hours following surgery (P 0.0001). Shukla et al. [11] found that the dexmedetomidine group used the least quantity of injectable diclofenac sodium, whereas the Mgso4 group used the most and the control group used the most.

Although Group D's block quality was superior to that of the other groups, there was no statistically significant difference in our study which correlated with Shukla et.al[11]. At 6 hours, VAS in Group A (3.90 0.30) was substantially greater than in Group B (1.50 0.51) and Group C (1.25 0.75) (P = 0.001) by Shukla et al. [11] which are in concordance to our study where the VAS score was nil for all the patients until 5 hours. It was less than 4 until 12 hours in Group D whereas it became 4 at 10 hrs in Group M and rescue analgesia was given. Rescue analgesia was given at 16 hours in group D The results by Mukherjee et al. [6]whofound that postoperative VAS values at 24 h were considerably lower in the magnesium group complementing our findings. Hemodynamic parameters in our study were comparable between the groups which are complemented by various studies. [11,18,20]

Nausea sedation bradycardia and skin rashes were seen in the dexmedetomidine group as side effects which were non significant, strengthening observations of our study [11,18,19]

Conclusion:-

When used in conjunction with Bupivacaine, Dexmedetomidine or MgSO4 effectively blocks the supraclavicular brachial plexus. When compared to patients receiving MgSO4, patients receiving dexmedetomidine have sensory and motor blocks that begin earlier, endure longer, and have smaller postoperative rescue analgesia requirements. With dexmedetomidine, there is a greater frequency but non-significant incidences of hypotension, bradycardia, and better sedation score.

Tables

Table 1:- Demographic data.

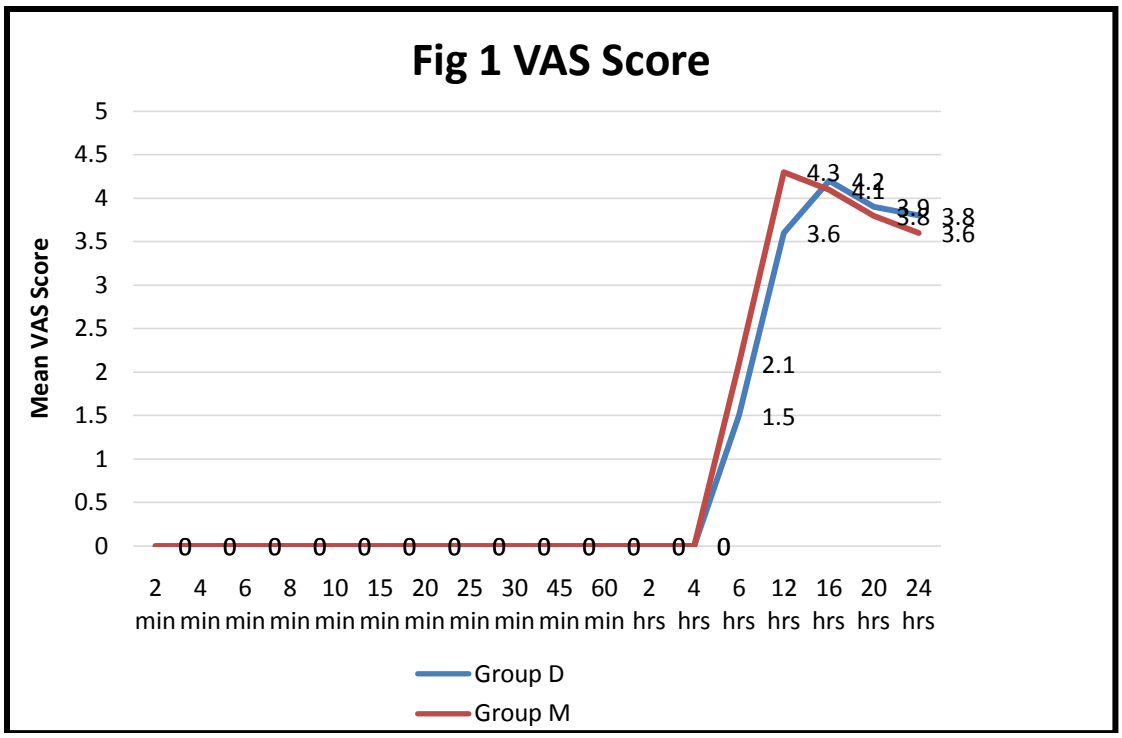
Characteristics	**Group D** (n=30)	**Group M** (n=30)	**P**
Age(years) (Mean ± SD)	49.2±9.01	50.4±7.91	0.58(NS)
Weight (Kg) (Mean ± SD)	59.03±6.32	57.56±6.67	0.38(NS)
Duration of Surgery (Min) (Mean±SD)	117.1±15.96	116.83±19.42	0.95(NS)
ASA (I:II)	`26:4	`25:5	0.71(NS)
Sex (Male: Female) (%)	`73.3 : 26.6	`70:30	0.77(NS)
P>0.05 difference is not significant			

Table 2:- Comparison of study parameters between both groups.

TIME PERIODS	**Group D (n=30)**	**Group M (n=30)**	**P**
Onset of sensory blockade (min)	5.43±0.48	7.09±0.14	P < 0.0001
Duration of sensory blockade (min)	905.9±17.48	512.66±37	P < 0.0001
Onset motor blockade (min)	8.14±0.56	10.87±0.71	P < 0.0001
Duration motor blockade (min)	815.74±4.98	524.52±9.99	P < 0.0001
Duration of analgesia (min)	1012.2 ± 24.15	607.4±11.72	P < 0.0001
Total analgesics (mg) in 24hrs	211.66±8.31	281.4±12.54	P < 0.0001
P<0.05 the difference is significant; P < 0.0001 = highly significant			

Table 3:- Quality of Anaesthesia.

Grades	Group D n=30	Group M n=30	P value
4	26 (86.66%)	18 (60%)	S
3	4 (13.33%)	12(40%)	S
2	0	0	-
1	0	0	-
P<0.05 the difference is significant; P < 0.0001 = highly significant			



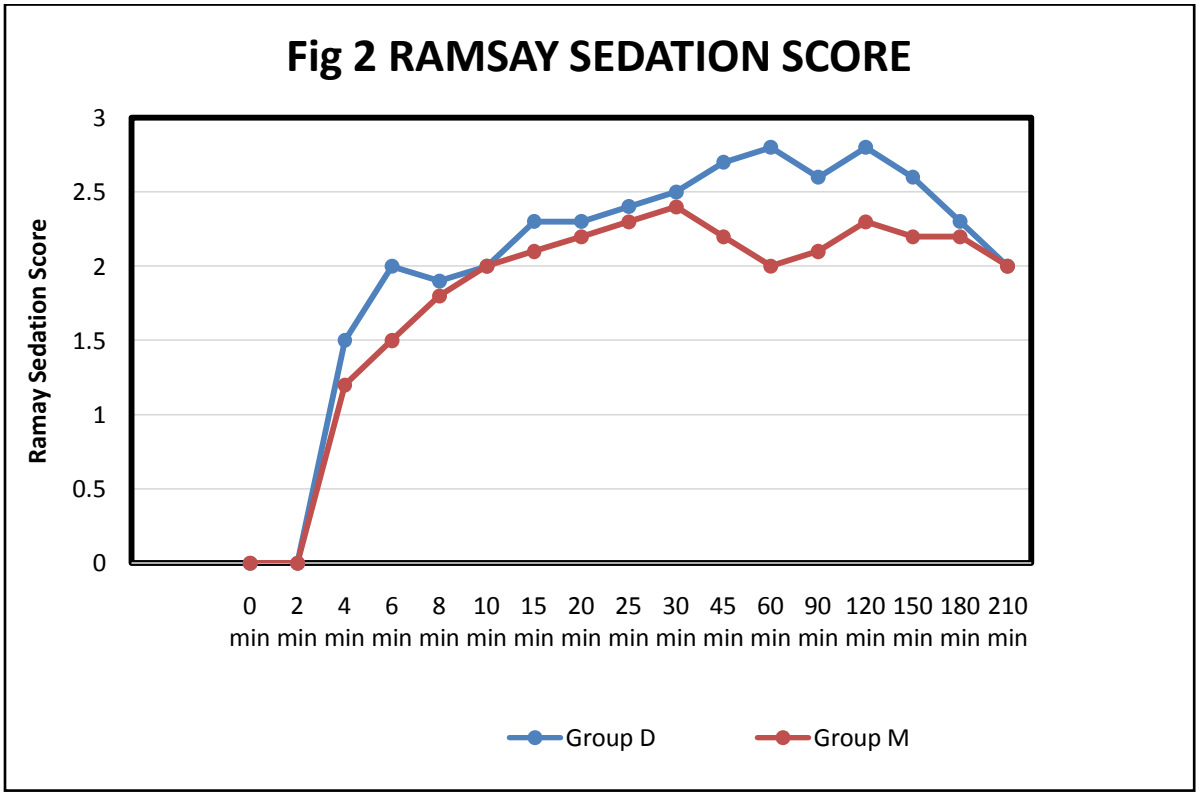
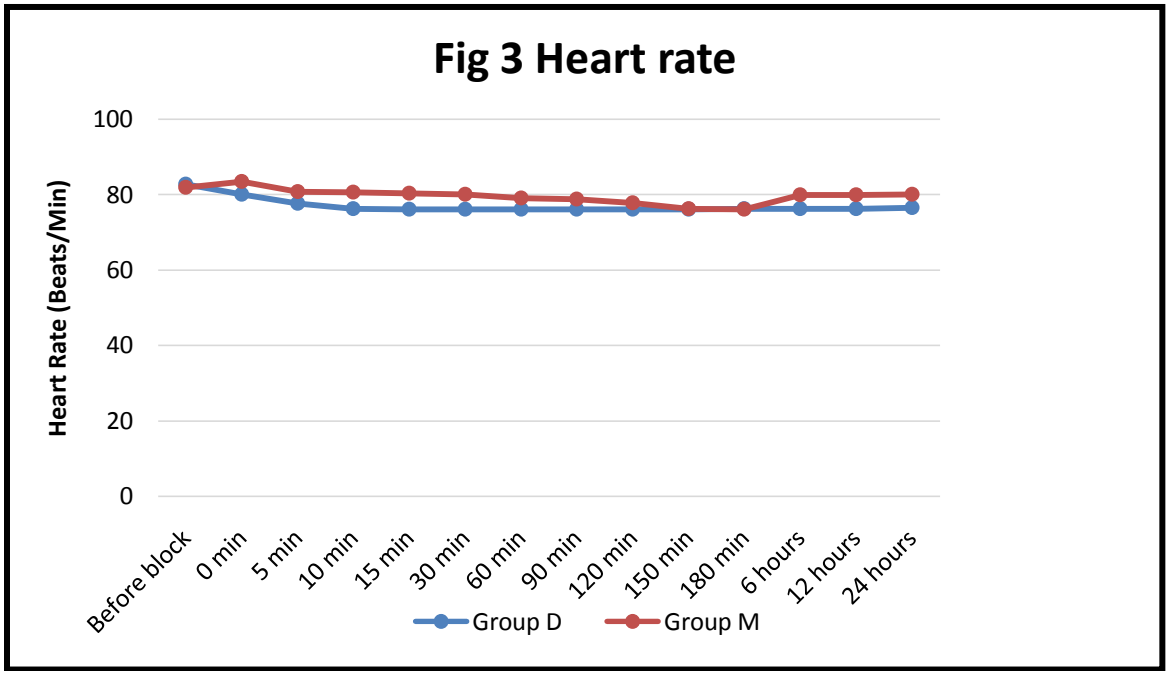
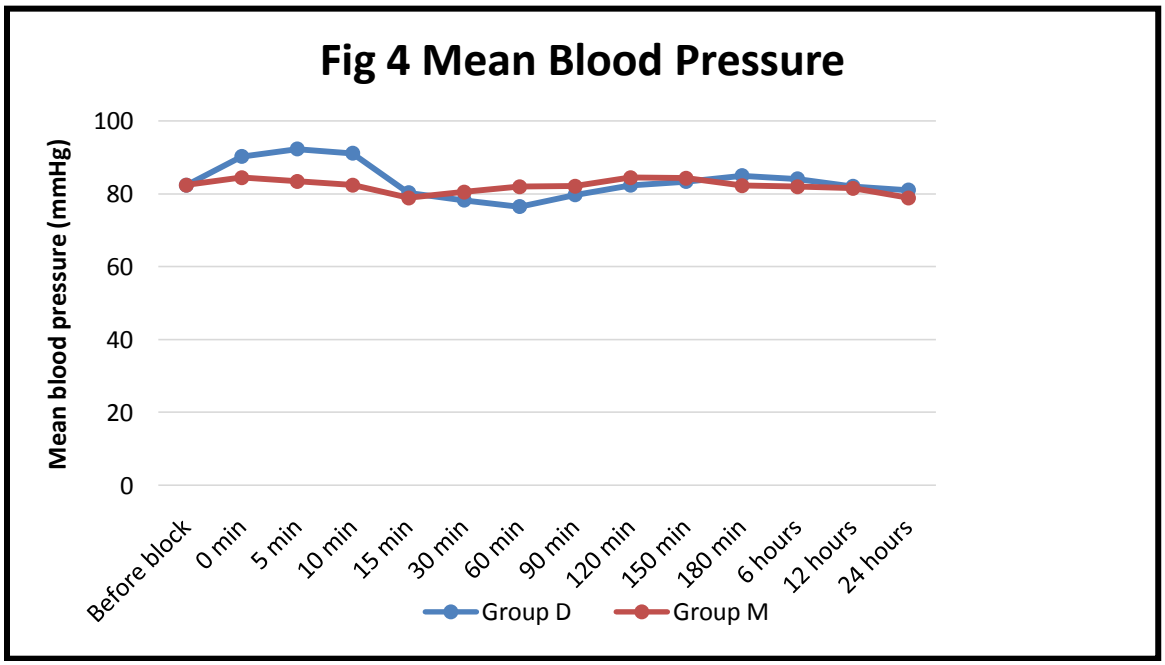


Table 4:- Adverse effects.

	Group D (n=30)	Group M (n=30)	P value

	N	%	N	%	
Nausea	3	10	1	3.3	0.3
Skin Rash	1	3.3	0	0	0.31
Bradycardia	4	13.3	0	0	0.03*
Hypotension	4	13.3	0	0	0.03*
Sedation	2	6.67	0	0	0.15
Hypoxia	0	0	0	0	0
Dryness of mouth	0	0	0	0	0
*P<0.05 difference is significant					





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