

Comparison of the Effect of Nitroglycerin, Magnesium Sulphate and Dexmedetomidine as Hypotensive Agents in Lumbar Spine Surgery

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ABSTRACT

Background: in orthopedic procedures more blood is lost from raw bone and muscle surface than from identifiable blood vessels. Moderate hypotensive anesthesia was found to significantly decrease the average blood loss by nearly 40%, reduce the need for transfusion by 45% and shorten the average operating time by nearly 10%.

Objective: The aim of the current study was to compare magnesium sulphate and dexmedetomidine with nitroglycerin as regard hypotensive effect as primary outcome, volume of blood loss, blood substitution and pattern of recovery as secondary outcome during lumbar spine surgery. **Patients and Methods:** This prospective, controlled, comparative, randomized, double blind study included a total of ninety patients aged 21-50 years of both sex, ASA I-II scheduled for elective lumbar spine surgery, attending at Department of Orthopedic, AL-Azher university Hospital in Assuit as single center study. Patients have received either dexmedetomidine, magnesium sulfate or nitroglycerine.

Results: There were highly significant difference ($P < 0.000$) with duration of surgery between different study groups with duration of surgery shortest in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group. There were highly significant differences between different study groups with fluid maintenance with higher volume in nitroglycerine group then magnesium sulfate group and then dexmedetomidine group. There were highly significant differences ($P < 0.000$) with systolic blood pressure between study groups at A1 and hypotensive agent discontinuation with lowest systolic blood pressure in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

Conclusion: nitroglycerine, magnesium sulfate and dexmedetomidine could induce hypotension, but dexmedetomidine showed more favorable hemodynamic profile as regard blood pressure and heart rate.

Keywords: Nitroglycerin, Magnesium Sulphate, Dexmedetomidine, Hypotensive agents, Lumbar spine surgery.

INTRODUCTION

In orthopedic procedures more blood is lost from raw bone and muscle surfaces than from identifiable blood vessels. A radioactive isotope study of blood loss in major orthopedic procedures showed that estimates of blood losses were, on average, 50% of the true measured loss⁽¹⁾. Laminectomy and spinal fusion are associated with increased blood loss due to bleeding from the extensive epidural venous plexuses and poses possibility of nerve injury root level if not visualized properly. Nerve roots are at jeopardy during laminectomy and decrease hemorrhage adds to safety of surgery in this area⁽²⁾.

Moderate hypotensive anaesthesia was found to significantly decrease the average blood loss by nearly 40%, reduce the need for transfusion by nearly 45% and shorten the average operating time by nearly 10%⁽²⁾.

Deliberate hypotension is defined as the intentional reduction of the systemic perfusion pressure. Deliberate hypotension is defined as reduction in systolic blood pressure (SBP) to 80-90mm Hg (30% decrease in the SBP from the baseline pressure) or a decrease in the mean arterial pressure (MAP) to 50-65 mm Hg in normotensive patients⁽³⁾.

Many anesthetic agents and vasoactive drugs are used frequently to produce controlled hypotension, including inhalational anesthetics, direct-acting vasodilators, autonomic ganglion blockers, β -adrenergic blockers, and calcium channel blockers⁽⁴⁾. It was in 1985 M Guggiari et al., used nitroglycerine (NTG) for the first time to produce induced hypotension in aneurismal brain surgery and proved that it can be used as a sole agent for hypotension⁽⁵⁾.

The decrease in arterial pressure is achieved by vasodilatory effect of NTG on arterial and venous bed resulting finally in decreased venous and right heart filling and so decreased cardiac output. Nitroglycerine causes either no change or slight tachycardia during continuous infusion as slight increase in heart rate is reflex phenomenon, baroreceptor response secondary to hypotension produced⁽⁶⁾.

I.V. magnesium sulphate may be a good agent for deliberate hypotension because magnesium intervenes in the activation of membrane Ca ATPase and Na-K ATPase involved in transmembrane ion exchanges during depolarization and repolarization phases, and thus act as a stabilizer of cell membrane and intracytoplasmic organelles⁽⁷⁾. The antagonist effect of magnesium at N-methyl-D-aspartate (NMDA) receptors has led to studies of its adjuvant effect in perioperative analgesia⁽⁸⁾. Dexmedetomidine (DEX) is a potent highly selective α_2 adrenergic agonist, possessing a differential specificity for the α_2 : α_1 receptors⁽⁹⁾. DEX has sedative, analgesic, anesthetic sparing effect, and sympatholytic properties⁽¹⁰⁾. The central and peripheral sympatholytic action of DEX is mediated by α_2 adrenergic receptors⁽¹¹⁾ and is manifested by dose-dependent decrease in arterial blood pressure, heart rate, cardiac output and norepinephrine release⁽¹⁰⁾.

The aim of the current study was to compare magnesium sulphate and dexmedetomidine with nitroglycerin as regard hypotensive effect as primary outcome, volume of blood loss, blood substitution and pattern of recovery as secondary outcome during lumbar spine surgery.

PATIENTS AND METHODS

This prospective, controlled, comparative, randomized, double blind study included a total of ninety patients aged 21-50 years of both sex, ASA I-II scheduled for elective lumbar spine surgery, attending at Department of Orthopedic, AL-Azher university Hospital in Assuit. Written informed consent from all the subjects were obtained. This study was conducted between January 2017 to February 2018.

Ethical approval:

Approval of the Hospital Ethics Committee was obtained.

Exclusion criteria:

- ASA grade III, IV, uncontrolled diabetes mellitus, pulmonary disease, uncontrolled hypertension, ischemic heart disease, gastro-esophageal reflux disease, cerebral ischemia and renal impairment.
- History of difficult airway management.
- Body mass index >40, history of neuromuscular disease, pregnancy.
- Known allergy to all study drugs.
- Prior treatment with calcium channel blockers, opioids, anticoagulants and patients receiving magnesium supplementation or drugs known to have a significant interaction with NMDAs.
- Duration of surgery > 150 min

Grouping:

According to computer program and use of opaque sealed envelope, the included subjects were randomly allocated into three equal groups, 30 subjects each; Group N (nitroglycerin, control group), Group M (magnesium sulfate group) and group D (dexmedetomidine group).

Preparation: Patients have received either dexmedetomidine, magnesium sulfate or nitroglycerine.

Group N (controls) received saline IV starting 10 minutes before the beginning of surgery and nitroglycerine infusion started after induction.

Group D received dexmedetomidine IV starting 10 minutes before the beginning of surgery and continued during the operation.

Group M received MgSO₄ IV starting 10 minutes before the beginning of surgery and continued during the operation. Target blood pressure lowering 30%. More than that we stop the study drug.

Premedication:

All patients were premedicated with IV midazolam (Dormicum, Roche, Switzerland) 0.02 mg/kg after insertion of 20 G peripheral IV catheter.

Group N (controls) (Glyceryl Trinitrate, Hameln pharma plus gmbh, Germany) received 25 ml 0.9% saline infused over 10 minutes then received 3 µg/kg/min and was titrated to achieve and maintain the desired hypotension. Group D received loading dose of 1 µg dexmedetomidine (Precedex, sigma, united states) diluted in 25 ml 0.9% saline infused over 10 minutes followed by continuous IV infusion of 0.2 µg/kg/h.

Group M (Magnesium sulphate, Egypation international pharmaceutical, Egypt) the infusion started before induction at loading dose of 25mg/kg diluted in 25 ml 0.9% saline for 10 minutes and then was sustained throughout operation at maintenance dose of 15 mg/kg/h intravenously.

Anesthesia technique:

All patients received the same anesthetic technique using fentanyl 2µg/kg IV and propofol 1-2 mg/kg IV (till lose of eye lash reflex). The intubation was facilitated by the use of rocuronium 0.6 mg/kg IV.

Maintenance:

Group D received continuous IV infusion of 0.2 µg/kg/h.

Group M infusion was sustained throughout operation at maintenance dose of 15 mg/kg/h intravenously.

In control group (N) the induction started with 3 µg/kg/min and was titrated to achieve and maintain desired hypotension. Anesthesia was maintained with 0.5-1% end-tidal isoflurane in 100% oxygen. Adequate muscle relaxation was maintained with incremental bolus doses of 0.1-0.2 mg/kg IV rocuronium when indicated by peripheral nerve stimulation. Controlled ventilation was adjusted to maintain normocapnia (30-35 mmHG).

Fluid therapy included maintenance plus deficit fluids that was replaced over the first 3 to 4 hours of the procedure and third space losses which was replaced by 6 ml/kg/h.

Monitoring:

Continuous monitoring of invasive blood pressure, non-invasive blood pressure in PACU, HR, Spo₂, ETCO₂, ECG, urine output and sudden changes in plans.

Parameters of study: Data collected to compare between the three groups (DEX, MgSO₄ and nitroglycerin):

- Demographic data
- Blood loss estimated by Fromme score and blood transfusion
- Pulse rate at time of induction, at start of hypotensive agent, 15, 30, 45, 60 minutes, at hypotensive agent discontinuation and after extubation.
- Blood pressure (systolic, diastolic and mean) at time of induction, at start of hypotensive agent, 15, 30, 45, 60 minutes, at hypotensive agent discontinuation and after extubation.
- O₂ saturation, arterial blood gases and UOP at time of induction, at start of hypotensive agent, 15, 30, 45, 60 minutes, at hypotensive agent discontinuation and after extubation.
- Time required to restore MAP to baseline after discontinuation of the study drug
- At the end of surgery groups was compared with reference to blood loss by fromme score
- Modified alvert score
- Time to 1st analgesic rescue in PACU
- Blood pressure, pulse rate, O₂ saturation, ETCO₂, UOP in PACU.

Statistical analysis

- SPSS program (statistical package for social science) will be used for data entry and analysis.
- Mean and standard deviation will be used for expression of quantitative data, percent will be used for expression of qualitative data.
- Anova and chi-square will be used to assess difference between the three groups.

RESULTS

Table (1) shows Demographic data in study groups. There were non significance differences ($P>0.05$) between age, sex, weight, height and BMI.

Table (1): Demographic data in study groups.

Item	N	M	D	P-value
1-Age (years)	42.50±6.94	44.86±13.96	48.43±12.20	P=0.204n.s
2-Sex:				
Male	15(50.0%)	22(73.3%)	13(43.3%)	P=0.448n.s
Female	15(50.0%)	8(20.0%)	17(56.7%)	
3- Weight (kg)	83.00±6.51	85.33±6.28	78.67±7.97	P=0.264n.s
4-Height (cm)	160.00±7.34	175.00±4.54	167.40±5.01	P=0.437n.s
5-BMI (kg/m ²)	26.84±4.46	27.87±1.96	28.02±2.04	P=0.214n.s

- * Significant
- ** Moderately significant
- *** Highly significant

Table (2) shows clinical data in study groups. There were highly significance differences ($P<0.000$) between different study groups with each of duration of surgery. Also there were moderate significance difference ($P<0.001$) with fluid maintenance.

Table (2): Clinical data in study groups.

Item	N	M	D	P-value
1- Duration of surgery (hr)	2.25±0.13	1.89±0.26	1.33±0.45	P<0.000***
2- Fluid maintenance (ml)	188.00±23.01	123.00±6.51	122.67±14.95	P<0.001**

Table (3) shows systolic blood pressure in study groups. There were highly significance difference ($P<0.000$) between study groups at A1 & A5. There were significance difference between study groups ($P<0.05$) at A15&A30. But there were non significance difference ($P>0.05$) between study groups at other times.

In group N when comparing with baseline. There were highly significance difference ($P<0.000$) with A60, there were moderate significance difference ($P<0.001$) at A45, also there were significance difference ($P<0.05$) with A15 & A30.

In group M when comparing with baseline. There were moderate significance difference ($P<0.001$) at A45, also there were significance difference ($P<0.05$) with A5, A15, A30 & A45.

In group D when comparing with baseline. There were significance difference ($P<0.05$) with A45 & A60.

When comparing between group N & group M, there were moderate significance difference ($P<0.001$) between study groups at A15 & Hypotensive agent discontinuation, also there were significance difference between study groups ($P<0.05$) at A30 & A45. But there were non significance differences ($P>0.05$) between study groups at other times.

When comparing between group N & group D There were moderate significance there were non significance difference ($P>0.05$) between study groups at different times.

When comparing between group M & group D There were moderate significance difference ($P<0.001$) between study groups at A15 & Hypotensive agent discontinuation, also there were significance difference between study groups ($P<0.05$) at A15, A30 & A45. But there were non significance difference ($P>0.05$) between study groups at other times.

Table (3): Systolic blood pressure in mmHg in study groups.

Item	N	M	D	P-value
4-A30	118.86±18.22	110.00±5.73	105.03±4.08	P<0.005**
5-A45	110.67±14.76	98.80±8.75*	94.50±7.04	P<0.004**
6-A60	105.80±11.00*	97.90±6.02*	93.10±8.61	P<0.04*
7-Hypotensive agent discontinuation	101.93±10.74*	98.50±8.30*	94.16±8.75	P<0.04*
8-After extubation	97.60±13.81**	89.60±11.88**	88.56±10.23*	P=0.385n.s
	95.20±13.77***	93.90±6.45*	90.20±9.44*	P=0.254n.s
	118.40±11.92	111.00±9.76	99.63±11.67	P=0.424n.s
	129.73±7.71	125.00±13.15	124.43±17.31	P=0.245n.s

Intragroup: *significant,
 **moderately significant,
 ***highly significant

Item	P1&P2	P1&P3	P2&P3
1-A1	P=0.265n.s	P=0.084n.s	P<0.000***
2-A5	P=0.168n.s	P=0.966n.s	P<0.04*
3-A15	P<0.004**	P=0.211n.s	P<0.01*
4-A30	P<0.02*	P=0.565n.s	P<0.04*
5-A45	P<0.04*	P=0.138n.s	P=0.719n.s
6-A60	P=0.195n.s	P=0.914n.s	P=0.082n.s
7-Hypotensive agent discontinuation	p<0.001**	P=0.832n.s	P<0.000***
8-After extubation	p=0.131n.s	P=0.095n.s	P=0.887n.s

Table (4) shows diastolic blood pressure in study groups. There were moderate significance difference (P<0.001) between study groups at A30. But there were non significance difference (P>0.05) between study groups at other times. In group N when comparing with baseline. There were significance difference (P<0.05) with A45 & A60.

In group M when comparing with baseline. There were significance difference (P<0.05) with A15, A30, A45 & A60. In group D when comparing with baseline. There were moderate significance difference (P<0.001) with A30.

When comparing between group N& groupM There were non significance difference (P>0.05) between study groups at different times.

When comparing between group N& groupD There were moderate significance there were significance difference (P<0.05) between study groups at A30.

When comparing between group M & groupD. There were highly significance difference (P<0.000) at A30. But there were non significance difference (P>0.05) between study groups at other times.

Table (4): Diastolic blood pressure in mmHg in study groups.

Item	N	M	D	P-value
1-A1	71.80±9.59	73.33±12.31	76.23±11.14	P=0.294n.s
2-A5	69.40±9.01	66.67±13.55	64.96±8.71*	P=0.463n.s
3-A15	67.80±11.39	64.80±12.14*	61.96±13.25*	P=0.942n.s
4-A30	68.10±6.29	62.93±10.62*	59.50±10.30**	P<0.002**
5-A45	65.50±12.95*	63.00±11.86*	59.16±11.53**	P=0.403n.s
6-A60	62.40±10.90*	64.33±13.23*	60.23±13.14**	P=0.448n.s
7- Hypotensive agent discontinuation	70.50±10.59	70.73±14.42	70.16±13.31	P=0.985n.s
8-After extubation	78.40±8.37	81.60±8.23	80.67±14.69	P=0.505n.s

Intragroup: *significant
 **moderately significant
 ***Highly significant

Item	P1&P2	P1&P3	P2&P3
Hypotensive agent discontinuation After extubation	P=0.343n.s	P=0.593n.s	P=0.104n.s
	P=0.566n.s	P=0.562n.s	P=0.139n.s
	P=0.960n.s	P=0.743n.s	P=0.716n.s
	P=0.209n.s	P<0.02*	P<0.000***
	P=0.210n.s	P=0.280n.s	P=0.917n.s
	P=0.233n.s	P=0.539n.s	P=0.490n.s
	P=0.875n.s	P=0.943n.s	P=0.915n.s
	P=0.763n.s	P=0.141n.s	P=0.466n.s

Table (5) shows time required to restore the MAP to baseline after discontinuation of the study drug & time to first analgesic rescue in PACU. There were highly significance (P<0.000) with time required to restore the MAP to baseline after discontinuation of the study drug & time to first analgesic rescue in PACU.

Table (5): Time required to restore the MAP to baseline after discontinuation of the study drug & time to first analgesic rescue in PACU.

Item	N	M	D	P-value
1- Time required to restore the MAP to baseline (min)	11.90±2.59	15.67±2.53	17.70±2.36	P<0.000***
2- Time to first analgesic rescue in PACU (min)	16.50±3.41	18.17±1.26	20.00±0.00	P<0.000***

Table (6) shows Heart in study groups. There were moderate significance difference (P<0.001) between study groups at after extubation. Also there were significance difference (P<0.05) At time A5 & A15. But there were non significance difference (P>0.05) between study groups at other times.

In group N when comparing with baseline. There were significance difference (P>0.05) in different times.

In group M when comparing with baseline. There were significance difference (P<0.05) in after extubation and non-significance difference (P>0.05) at different times.

In group D when comparing with baseline. There were moderate significance difference

(P<0.001) with after extubation. Also, there were significance difference (P<0.05) with A5 & A15.

When comparing between group N& groupM There were non significance difference (P>0.05) between study groups at different times.

When comparing between group N& groupD There were non significance difference (P>0.05) between study groups at different times.

When comparing between group M & groupD. There were highly significance difference (P<0.000) at After extubation. But there were non significance differences (P>0.05) between study groups at other times.

Table (6): Heart rate in beat/min in study groups.

Item	N	M	D	P-value
1-A1	101.30±11.32	77.46±12.65	60.20±12.53	P=0.084n.s
2-A5	105.70±10.18	82.26±16.42	62.06±12.62	P<0.04*
3-A15	102.40±11.69	76.80±12.91	62.83±13.48	P<0.017*
4-A30	104.40±10.92	78.33±15.65	68.36±9.44	P=0.930n.s
5-A45	103.60±12.90	76.26±16.33	69.53±9.97	P=0.509n.s
6-A60	102.30±10.57	76.00±14.85	71.90±11.25	P=0.609n.s
7- Hypotensive agent discontinuation	100.50±11.84	79.40±11.60	78.60±15.81**	P=0.827n.s
8-After extubation	98.70±10.37	96.13±13.16*	90.16±10.48**	P<0.003**

Intragroup:*significant

**moderately significant

***highly significant

Item	P1&P2	P1&P3	P2&P3
1-A1	P=0.319n.s	P=0.221n.s	P<0.02*
2-A5	P=0.062n.s	P=0.903n.s	P<0.01*
3-A15	P=0.249n.s	P=0.084n.s	P<0.005**
4-A30	P=0.992n.s	P=0.760n.s	P=0.697n.s
5-A45	P=0.718n.s	P=0.486n.s	P=0.192n.s
6-A60	P=0.398n.s	P=0.928n.s	P=0.360n.s
7-Hypotensive agent discontinuation	P=0.739n.s	P=0.491n.s	P=804n.s
8-After extubation	P=0.074n.s	P=0.141n.s	P<0.000***

Table (7) shows systolic blood pressure in study groups. “PACU”. There were highly significance difference (P<0.000) between groups at different time.

In group N there were significance difference (P<0.05) at time 30 & 35 mins. As regard there were moderate significance difference (P<0.001) at times 40-60mins.

In group M there were significance difference (P<0.05) at time 55 & 60 mins.

In group D there were significance difference (P<0.05) at time 25 - 60 mins.

When comparing group N&M there were highly significance difference (P<0.000) at time 10-60mins.

When comparing N & D there were significance difference (P<0.05) at time 55-60mins.

When comparing M & D there were significance difference (P<0.05) at time 25-60 mins.

Table (7): Systolic blood pressure in mmHg in study groups. “PACU”

Item	N	M	D	P-value
1-5mins	117.70±9.25	108.67±6.33	109.06±7.39	P<0.000***
2-10mins	116.90±5.23	106.73±5.48	102.40±2.01	P<0.000***
3-15mins	115.30±2.98	106.13±6.15	102.13±2.88	P<0.000***
4-20mins	114.00±2.31	106.00±5.09	103.06±2.42	P<0.000***
5-25mins	112.00±2.22	106.20±6.35	101.23±2.56*	P<0.000***
6-30mins	110.80±2.56*	106.60±5.83	101.36±3.11*	P<0.000***
7-35mins	109.30±1.70*	106.67±5.67	102.86±3.02*	P<0.000***
8-40mins	108.90±2.69**	106.93±5.33	100.50±5.73*	P<0.000***
9-45mins	107.70±2.65**	105.86±6.76	99.53±4.08*	P<0.000***
10-50mins	107.10±1.15**	103.73±5.15	100.76±3.72*	P<0.000***
11-55mins	106.90±0.93**	102.13±4.91*	100.86±5.25*	P<0.000***
12-60mins	105.90±2.20**	101.13±4.19*	100.36±5.38*	P<0.000***

Intragroup:*significant

**moderately significant

***highly significant

Table (7): Systolic blood pressure in mmHg in study groups. “PACU”

Item	P1&P2	P1&P3	P2&P3
1-5mins	P=0.823n.s	P<0.001**	P<0.01*
2-10mins	P<0.000***	P<0.001**	P<0.001***
3-15mins	P<0.002**	P<0.001**	P<0.01*
4-20mins	P<0.006**	P<0.01*	P<0.01*
5-25mins	P<0.000***	P<0.000***	P<0.01*
6-30mins	P<0.000***	P=0.583n.s	P<0.001**
7-35mins	P<0.002**	P=0.526n.s	P<0.001**
8-40mins	P<0.000***	P=0.261n.s	P<0.01*
9-45mins	P<0.000***	P=0.336n.s	P<0.01*
10-50mins	P<0.000***	P=0.475n.s	P<0.02*
11-55mins	P<0.000***	P=0.584n.s	P<0.01*
12-60mins	P<0.000***	P=0.586n.s	P<0.02*

Table (8) shows Diastolic blood pressure in study groups. “PACU”. There were highly significance difference (P<0.000) between groups at different times.

When comparing between group N& groupM. There were highly significance difference (P<0.000) at different times.

When comparing between group N& groupD. There were highly significance difference (P<0.000) at

25mns., also there were moderate significance difference (P<0.001) at times 5- 15mns. As regard there were significance difference (P<0.05) at time 20, there were non significance difference (P>0.05) at other times.

When comparing group M&groupD there were moderate significance difference (P<0.001) at times 10, 30 & 35 mns. Also, there were significance difference (P<0.05) at other times.

Table (8): Diastolic blood pressure in mmHg in study groups. “PACU”

Item	N	M	D	P-value
1-5mins	73.90±8.46	70.93±7.50	62.50±12.46	P<0.000***
2-10mins	70.70±4.77	68.67±8.60	58.43±5.98	P<0.000***
3-15mins	65.90±6.09	67.67±6.67	58.10±7.31	P<0.000***
4-20mins	66.50±4.07	58.67±7.06	57.03±6.02	P<0.000***
5-25mins	63.90±5.42	57.00±8.26	56.80±4.05	P<0.000***
6-30mins	62.50±4.10	58.33±5.77	56.13±3.73	P<0.000***
7-35mins	65.50±5.30	59.33±7.15	55.36±3.96	P<0.000***
8-40mins	64.00±5.93	56.00±7.92	56.23±5.56	P<0.000***
9-45mins	65.00±7.54	58.66±7.97	56.40±3.59	P<0.000***
10-50mins	63.50±4.57	58.00±5.18	57.36±3.89	P<0.000***
11-55mins	64.50±4.79	56.67±6.60	57.76±3.75	P<0.000***
12-60mins	65.00±4.54	58.00±5.18	58.10±3.04	P<0.000***

Intragroup:*significant

**moderately significant

***highly significant

Item	P1&P2	P1&P3	P2&P3
1-5mins	P=0.823n.s	P<0.001**	P<0.01*
2-10mins	P<0.000***	P<0.001**	P<0.001**
3-15mins	P<0.002**	P<0.001**	P<0.01*
4-20mins	P<0.006**	P<0.01*	P<0.01*
5-25mins	P<0.000***	P<0.000***	P<0.01*
6-30mins	P<0.000***	P=0.583n.s	P<0.001**
7-35mins	P<0.002**	P=0.526n.s	P<0.001**
8-40mins	P<0.000***	P=0.261n.s	P<0.01*
9-45mins	P<0.000***	P=0.336n.s	P<0.01*
10-50mins	P<0.000***	P=0.475n.s	P<0.02*
11-55mins	P<0.000***	P=0.584n.s	P<0.01*
12-60mins	P<0.000***	P=0.586n.s	P<0.02*

Table (9) shows heart rate in study groups. “PACU”. There were highly significance difference (P<0.000) between groups at different times.

When comparing between group N & groupM. There were non significance difference (P>0.05) at different times.

When comparing between group N& groupD. There were highly significance difference (P<0.000) at 5-

30 mns., also there were moderate significance difference (P<0.001) at times 35- 55mns. As regard there were significance difference (P<0.05) at time 20, there were non significance difference (P>0.05) at other times.

When comparing group M&groupD there were moderate significance difference (P<0.001) at times 60 mins. Also, there were highly significance difference (P<0.000) at other times.

Table (9): Heart Rate in beat/min in study groups. “PACU”

Item	N	M	D	P-value
1-5mins	92.10±9.33	79.53±9.96	73.00±8.60	P<0.000***
2-10mins	87.50±8.08	77.53±8.40	74.13±6.50	P<0.000***
3-15mins	86.60±8.07*	77.06±8.07	74.26±6.04	P<0.000***
4-20mins	86.20±8.57*	76.67±8.74	73.20±5.01	P<0.000***
5-25mins	86.60±6.68*	79.00±8.63	73.00±5.25	P<0.000***
6-30mins	86.90±8.11*	78.20±7.86	74.63±6.36	P<0.000***
7-35mins	86.10±8.47*	78.00±8.65	75.76±6.27	P<0.000***
8-40mins	86.20±8.37*	79.06±8.69	76.76±6.71	P<0.000***
9-45mins	86.00±8.42*	79.00±8.36	77.33±6.33*	P<0.000***
10-50mins	86.10±8.76*	78.73±8.34	77.86±6.47*	P<0.000***
11-55mins	86.50±8.53*	78.93±8.39	78.16±6.52*	P<0.000***
12-60mins	87.20±8.27*	80.06±8.28	78.06±7.43*	P<0.000***

Intragroup:*significant
 **moderately significant
 ***highly significant

Item	P1&P2	P1&P3	P2&P3
1-5mins	P=0.155n.s	P<0.000***	P<0.000***
2-10mins	P=0.758n.s	P<0.000***	P<0.000***
3-15mins	P=0.517n.s	P<0.000***	P<0.000***
4-20mins	P=0.083n.s	P<0.000***	P<0.002**
5-25mins	P=1	P<0.000***	P<0.000***
6-30mins	P=0.40n.s	P<0.000***	P<0.000***
7-35mins	P=0.905n.s	P<0.001**	P<0.000***
8-40mins	P=0.256n.s	P<0.002**	P<0.000***
9-45mins	P=0.729n.s	P<0.002**	P<0.000***
10-50mins	P=0.655n.s	P<0.001**	P<0.000***
11-55mins	P=0.694n.s	P<0.001**	P<0.000***
12-60mins	P=0.625n.s	P<0.000***	P<0.001**

Table (10) shows complication in study groups. There were highly significance difference (P<0.000) between different groups with blood transfusion Bradycardia, Atropine and Esmolol. As regard there were moderate significance difference (P<0.001) with blood loss, Tachycardia.

Table (10): Complication in study groups.

Item	N	M	D	P-value
Blood loss	478.00±135.02	386±200.06	363.33±180.48	P<0.001**
Blood transfusion (ml)				
Tachycardia	700.00±258.19	500.00±0.00	377.50±44.59	P<0.000***
Bradycardia	18(60.0%)	9(30.0%)	4(13.3%)	P<0.001**
Atropine	0.0	10(33.3%)	24(80.0%)	P<0.000***
Esmolol	0.0	9(30.0%)	21(70.0%)	P<0.000***
	16(53.3%)	8(26.6%)	3(10.0%)	P<0.000***

DISCUSSION

The present study was designed to compare the effects of nitroglycerine, magnesium sulfate and dexmedetomidine as hypotensive agent in lumbar spine surgery.

As regarding systolic blood pressure, there was significant statistical difference at time of induction, at start of hypotensive agent, at 15 minute and at 30 minute intraoperative with blood pressure lower in dexmedetomidine group followed by magnesium sulfate group followed by nitroglycerine group.

As regarding diastolic blood pressure there was significant statistical difference at 30 minutes with blood pressure lower in dexmedetomidine followed by magnesium sulfate group and then nitroglycerine group.

As regarding heart rate there was significant statistical difference at start of hypotensive agent, at 15 minutes and after extubation with heart rate lower in dexmedetomidine followed by magnesium sulfate group and then nitroglycerine group.

However, in early postoperative period there was statistically significant difference in systolic blood pressure in all values with blood pressure lower in dexmedetomidine followed by magnesium sulfate group and then nitroglycerine group.

There was significant statistical difference in diastolic blood pressure in all values with blood pressure lower in dexmedetomidine group followed by magnesium sulfate and then nitroglycerine group.

There was significant statistical difference in heart rate in all values with heart rate lower in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

These results of haemodynamics confirm that the haemodynamic profile of dexmedetomidine was steadier which can be attributed to the known sympatholytic effect of α_2 agonist.

This study agrees with **Elsharnouby & Elsharnouby** ⁽¹²⁾ who studied patients scheduled for endoscopic surgery and found statistically significant lower heart rate and mean blood pressure in magnesium sulfate group with greater quality of vision of the surgical field and shorter operative time compared with control group.

Jamaliya et al. ⁽¹³⁾ found that continuous infusion of dexmedetomidine is effective in minimizing blood loss and maintaining superior haemodynamics as compared with nitroglycerine in posterior fixation spine surgery.

Nasreen et al. ⁽¹⁴⁾ in study assessing the hypotensive effect of dexmedetomidine administered as a 0.4 $\mu\text{g}/\text{kg}/\text{h}$ IV infusion following a 1 $\mu\text{g}/\text{kg}$ IV bolus dose in middle ear surgery, it has been reported that surgeon satisfaction was increased and inhalation agent

necessity to decrease the mean arterial pressure up to 30% was decreased in dexmedetomidine administered patient group.

Secondary decrease in the heart rate and blood pressure caused by dexmedetomidine is considered to be responsible for this situation.

In study conducted by **Vali et al.** ⁽¹⁵⁾ comparing dexmedetomidine with nitroglycerine in patients undergoing posterior fixation surgery after traumatic spine fractures dexmedetomidine had better control over vital parameters e.g heart rate, mean arterial pressure, systolic blood pressure and diastolic blood pressure than nitroglycerine.

In study conducted by **Rokhtabnak et al.** ⁽¹⁶⁾ comparing dexmedetomidine with magnesium sulfate, blood pressure control was easier in the dexmedetomidine group that's number of patients that required nitroglycerine or analgesic rescue administration was lower in dexmedetomidine group.

As regard duration of surgery there was statistically significant difference with duration of surgery shorter in dexmedetomidine group followed by magnesium sulfate group then nitroglycerine group.

These results suggest that dexmedetomidine is the best regard visual field and duration of surgery.

With agreement to these results, study conducted by **Vali et al.** ⁽¹⁵⁾ to compare dexmedetomidine and nitroglycerine in posterior fixation surgery following traumatic spine surgery showed that surgeries in nitroglycerine group lasted for longer duration than dexmedetomidine group with difference being statistically significant.

As regarding blood loss there was statistically significant difference with blood loss lower in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

As regarding blood transfusion there was statistically significant difference with blood transfusion lower in dexmedetomidine group followed by magnesium sulfate group then nitroglycerine group.

As regard fromme score there was statistically significant difference with best result in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

These results confirm that dexmedetomidine give good visual field with less blood loss and less blood transfusion requirements.

With agreement to this study, study conducted by **Bayram et al.** ⁽¹⁷⁾ comparing nitroglycerine with magnesium sulfate and dexmedetomidine during functional endoscopic sinus surgery showed that bleeding score was significantly decrease in group D.

Another study conducted by **Vali et al.** ⁽¹⁵⁾ comparing dexmedetomidine with nitroglycerine in posterior fixation surgery following traumatic spine

surgery stated that the mean blood loss was significantly lesser in dexmedetomidine group than nitroglycerine group. The requirement of blood transfusion was significantly more in nitroglycerine group than dexmedetomidine group.

As regard tachycardia there was stastically significant difference with the highest in nitroglycerine group followed by magnesium sulfate group and then dexmedetomidine group.

As regard hypotension there was stastically significant difference with the highest in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

As regard bradycardia there was stastically significant difference with the highest in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

These results demonstrate that hypotension and bradycardia are adverse effects of dexmedetomidine, tachycardia is adverse effect of nitroglycerine.

With agreement to this study, a study conducted by **Vali et al.** ⁽¹⁵⁾ comparing dexmedetomidine with nitroglycerine in posterior fixation following traumatic spine injury showed that patients in nitroglycerine group had more episodes of tachycardia compared to dexmedetomidine group during the period of observation, also in nitroglycerine group none of the patients had episode of hypotension or bradycardia where as in dexmedetomidine group 1 patient had hypotension and 2 patients had bradycardia, but which were not stastically significant.

In the study by **Bayram et al.** ⁽¹⁷⁾ comparing dexmedetomidine and magnesium sulfate in functional endoscopic sinus surgery bradycardia occurred in 4 patients in dexmedetomidine group versus 1 patient in magnesium sulfate group.

In another study conducted by **Ghodraty et al.** ⁽¹⁸⁾ comparing magnesium sulfate and remifentanil there were 4 episodes of hypotension in magnesium sulfate group and 3 episodes in remifentanil group requiring pharmacological intervension (ephedrine boluses), a total of 3 patients in magnesium sulfate group and 1 patient in remfentanil group received atropine due to bradycardia.

As regard time required to restore blood pressure to baseline after discontinuation of hypotensive drug there was stastically significant difference with the time longer in dexmedetomidine group followed by magnasium sulfate group and then nitroglycerine group.

These results show that dexmedetomidine acts by selectively binding to α_2 receptors with great affinity while nitroglycerine prodoce its hypotensive action by liberating nitric oxide which has half life of 0.1 seconds.

Sedative effect of magnasium sulfate were attributed to its ability to inhibit NMDA receptors in non compatative way.

With agreement to this study a study conducted by **Khalifa & Awad** ⁽¹⁹⁾ comparing dexmedetomidine, magnasium sulfate and nitroglycerine during functional endoscopic sinus surgery showed that significant difference between the groups was present in analysis of the time needed to restore the basal values of mean arterial pressure with longer time in dexmedetasiumomidine group.

Another study conducted by **Jamaliya et al.** ⁽¹³⁾ comparing dexmedetomidine and nitroglycerine during posterior fixation surgery following traumatic spine injury showed that time to reversibility of the hypotensive state was lesser in the nitroglycerine group when compared to dexmedetomidine group.

As regard time to first analgesic rescue there was stastically significant difference with time longer in dexmedetomidine group followed by magnesium sulfate group and then nitroglycerine group.

These results demonstrate the analgesic properities of both drugs.

With agreement to this study a study conducted by **Khalifa & Awad** ⁽¹⁹⁾ comparing dexmedetomidine, magnesium sulfate and nitroglycerine during functional endoscopic sinus surgery showed that longer time to require postoperative analgesia in the dexmedetomidine group and magnesium sulfate group compared with nitroglycerine group.

Another study conducted by **Somayaji and Raveendra** ⁽²⁰⁾, studying effect of dexmedetomidine on blood loss and quality of surgical field in functional endoscopic sinus surgery showed that postoperatively, patients receiving dexmedetomidine didn't report pain for longer period where's time to first analgesic request for the patients in the control group was much shorter. This was found to be stastically significant.

CONCLUSION

We concluded that nitroglycerine, magnesium sulfate and dexmedetomidine could induce hypotension, but dexmedetomidine showed more favorable hemodynamic profile as regard blood pressure and heart rate.

Dexmedetomidine also showed shorter duration of surgery with less blood loss, less blood transfusion and favorable frommer score with more surgeon satisfaction.

Dexmedetomidine showed longest` time to 1st analgesic rescue in PACU comparing with magnesium sulfate and nitroglycerine.

So, it is advised to use dexmedetomidine to induce hypotension than magnesium sulfate and nitroglycerine.

However, Dexmedetomidine should be used with caution as it caused hypotension and bradycardia,

it had sedative effect with low alderst score comparing with nitroglycerine and magnesium sulfate.

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