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Original Article

EFFECT OF COMBINING EPIDURAL WITH GENERAL ANESTHESIA ON RECOVERY AFTER SPINE SURGERY: RANDOMIZED CONTROLLED STUDY

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ABSTRACT

Background: Fast track techniques have been applied to reduce surgical stress response and to provide effective perioperative analgesia, thereby improving patient's recovery and reducing postoperative morbidity. The present study was undertaken to assess the effect of using combined general/epidural anesthesia (CGEA) on early recovery after lumbar spine surgeries. **Subjects and Methods:** The current prospective randomized clinical study had included a total of 40 patients who underwent elective one or two level laminectomy/discectomy. Patients were randomized and divided into two groups; general anesthesia (GA) group (group I) and combined general/epidural anesthesia group (CGEA) (group II). Patient characteristics, anesthesia time, surgical time, heart rate, mean arterial pressure (MAP), anesthetic / analgesic requirements, the occurrence of intraoperative bradycardia and/or hypotension, time to extubation, time to post anesthesia care unit (PACU) discharge and duration of PACU stay were recorded and considered for analysis. **Results**: It was observed that CGEA was significantly associated with reduction of intraoperative anesthetics / analgesic requirements, shorter time to extubation, time for PACU discharge and duration of PACU stay but on the expense of higher incidence of intraoperative hypotension. **Conclusion**: This study proved that CGEA seems to be an effective fast track anesthetic protocol in patients undergoing elective lumbar spine surgeries.

Keywords: Combined epidural/general anesthesia, Lumbar spine surgeries, PACU, Hypotension

INTRODUCTION

Lumber laminectomy or discectomy are mostly performed under general anesthesia (GA) which is associated with many complications such as inadequate pain relief along with prolonged post-operative recovery [(1)].

Fast-track anesthetic management was demonstrated to be highly safe and efficient to improve patient recovery and satisfaction when compared with conventional care [(2)(3)]. Epidural anesthetic blockade is considered an effective component of many fast-track programs [(4)]. The combined application of general and epidural anesthesia (CGEA) has several advantages including reduction of surgical stress, adequate postoperative analgesia and faster recovery [(5)(6)].

This study aimed to assess the effect of using combined general/epidural anesthesia on early recovery after spine surgery.

SUBJECTS AND METHODS

After approval of the research ethics committee, this prospective, randomized, controlled, single-blinded clinical study was conducted in Zagazig University Hospitals from 12/2016 to 12/2017. Written informed consents were obtained from all the patients in the study.

Patients of both sexes, who aged from 18- 50 years old, were classified as American Society of Anesthesiologists (ASA) grade I-II, had body mass index (BMI) 25-30kg/m2 and underwent single or double level lumbar laminectomy or discectomy, were included in

the study. Patient was excluded if he/she refused the procedure or had local infection at site of catheter insertion, recurrent disc surgery, preexisting neurological deficit, emergency surgery, coagulopathies, acontraindication for study technique or medications.

All patients had been preoperatively evaluated one week before operation and rechecked at the night of surgery according to the standard protocols including history taking, clinical examination, assessment of the hemodynamics (blood pressure, heart rate) ,laboratory investigations (Complete Blood Count ,liver function , kidney function , Prothrombin time, Partial thromboblastin time and International Normalization Ratio (INR).

Patients were randomly assigned into one of two groups: GA group **(group I)** and CGEA group **(group II)**. Each group included 20 patients.

All patients were pre medicated by intra venous (IV) midazolam 0.05 mg/kg and intramuscular (IM) atropine 20µg/kg and preloaded with lactated Ringer's solution (15 ml/kg) immediately before admission to the operating room. On admission to the operating room, standard monitoring was applied including 5 leads electrocardiography, non-invasive blood pressure, pulse oximetry and end-tidal carbon dioxide after intubation, induction of anesthesia in Group I was done by propofol (1-2 mg/kg) and fentanyl (2 µg/kg), muscle relaxation was achieved by atracurium (0.5 mg/kg) followed by endotracheal intubation, after confirmation of ET intubation, mechanical ventilation started using tidal volume (6-8ml/kg) and appropriate respiratory rate to achieve end tidal CO2 between (30-35mmHg), anesthesia was maintained based on isoflurane with readjusted MAC in 100% oxygen and muscle relaxation was maintained by atracurium (20% of loading dose every 20 minutes). Fentanyl supplementation 50-100ug was given if MAP and HR increased by more than 30% of basal level.

Patients of **group II** were positioned in sitting position, a single shot epidural block was applied using15 ml of 0.25% bupivacaine via a Touhy needle insertion (at or one level below the level of planned surgical intervention). needle was removed and After confirming the success of epidural blockade by assessing level of sensory blockage using pin prick discrimination technique, general anesthesia was induced (as followed in group I). In case of failed epidural block, general anesthesia was induced and patient was excluded from the study.

Adequate anesthetic state was considered when heart rate (HR) and arterial blood pressure (ABP) remained stable for 10 minutes or more after the start of surgery. Intra operative hypotension, defined as MAP drop by ≥20% from baseline value, was corrected by IV fluids plus ephedrine 5 mg IV increments as appropriate.

At the end of surgical procedure, isoflurane was discontinued, after dressing of the surgical incision, the patient was repositioned in supine position and muscle relaxation was reversed using IV neostigmine (0.05 to 0.06 mg/kg) and atropine (0.01 to 0.02mg/kg). Trachea was extubated when extubation criteria were met and the patient was transferred to PACU and standard monitoring was continued. When the patient had showed the criteria of early recovery phase (modified Alderete score ≥ 9) [7], he/she was transferred to ward under basic monitoring of HR, ABP , pain control , postoperative complications allover ward stay.

Rescue analgesia in the form of IV nulbufen increments of 5 mg and up to 20 mg/dose was administered when patient suffered from moderate to severe pain.

The following data were collected:

A) Patient characteristics: Patient age, genders, Body mass index (BMI), ASA classification, anesthesia time (starting from anesthetic induction to tracheal extubation) and surgical time (starting from Skin incision to wound closure).

B) Heart rate, non-invasive mean arterial blood pressure (MAP) were recorded as baseline, after induction of anesthesia at 5, 10,15, 30,60,90 minutes after intubation and then at extubation and 10 minutes after extubation.

C) The maximum percentage of Isoflurane used during GA.

D) Total intraoperative IV supplemental fentanyl administered.

E) The occurrence of intraoperative bradycardia and/or hypotension.

F) Time to extubation (from neuromuscular reversal to extubation).

G) Time to PACU discharge (starting from extubation).

H) Duration of PACU stay (starting from extubation to modified Alderete score ≥ 9).

I) Pain scores are evaluated on arrival to the PACU, and10 and 30 minutes, then after 1, 4, 8, 12 and 24 hours postoperatively using visual analogue scale (VAS) [7]expressed as straight line starts from 0 (no pain) to 10 (worst pain imaginable) and patient marks the degree of pain on the line.

STATISTICAL ANALYSIS

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA) and MedCalc 13 for windows (MedCalc Software bvba, Ostend, Belgium). According to the type of data; qualitative data were represented as number and percentage, Parametric quantitative data were presented as mean and SD and Non-parametric quantitative data were presented as median and range. The following tests were used to test significant differences; Differences between Parametric quantitative data by Chi square test (X2)**,** Non-parametric quantitative multiple by student t-test or Mannwhitney test and Paired variables by paired t or sign. P value was set at <0.05 for significant results.

Sample size calculated to be 36 patient using Epi I program as expected mean of extubation time (from disconnection of inhalational anesthesia) in group I 8.36 ± 3.2 and that in **group II** 5.19 ± 3.0 at confidence interval 95% and power of test 80 %**.** 10 % added for lost cases. Total sample size was 40 patients, 20 patients in each group.

RESULTS

There was no significant difference between groups regarding demographic characteristics (age, sex, BMI and ASA score), operative time and anesthesia time (p > 0.05) (Table1).

There was no significant difference in HR between groups as baseline, immediately after induction of general anesthesia and up to 10 minutes after intubation (p > 0.05). At 15 minutes after intubation, Group I had significantly higher heart rate than group II (p < 0.05). There was no significant difference in heart rate between groups from 30 minutes after intubation till 10 minutes after extubation (p > 0.05) (Table 2).

There was no significant difference in MAP between groups when measured as baseline, immediately after induction of general anesthesia and up to 10 minutes after intubation (p > 0.05). Patients of Group I continued to have significantly higher MAP compared to this recorded in patients of group II from 10 minutes after intubation till endotracheal extubation (p < 0.05). MAP showed no significant difference between groups 10minutes after endotracheal extubation (p > 0.05) (Table 3).

Intraoperative, patients of group I required significantly higher percentage of inhaled isoflurane and IV fentanyl supplementation than patients of group II (p < 0.05) (Table 4).

Patients of group I showed significant longer time to extubation, PACU stay and time to PACU discharge than group II (p < 0.05) (Table 5).

Hypotension occurred in 16 out of 20 patients (80%) of CGEA group while 7 out of 20 patients (35%) suffered hypotension in control group which represented high significant difference (P < 0.05) and necessitated ephedrine administration. There was no significant difference between groups regarding incidence of bradycardia (7 out of 20 patients in CGEA group (35%) versus 4 out of 20 patients in control group (20%) (P> 0.05) (Table 6).

Patients of Group I had significantly higher VAS for pain than those of group II at all measuring points after extubation till 24 hrs postoperative (p < 0.05) also patients of group I required significantly higher postoperative doses of nalbuphine than those in groupie (p < 0.05) (Table 7).

Table 1 Demographic data, time of surgery and time of anesthesia

Parameter		**Group I(N=20)**	**Group II(N=20)**	**T**	**P**
Age (years)		38.05±9.5	37.4±6.41	0.254	0.80
BMI (kg/m^2)		24.60±2.7	26.3±1.89	1.394	0.18
Gender	Male	9(45.0%)	11(55. %)		0.72
	Female	11(55. %)	9(45.0%)		
ASA	I	15(75.0%)	16(80.0%)		0.93
	II	5(25.0%)	4(20.0%)		
Operative time (minutes)		118.7±27.3	115.25±28.3	0.398	0.69
Anesthesia time (minutes)		135.1±29.7	137.15±28.2	-0.217	0.83

Data were presented as mean and SD or as number and percentage
P <0.05 is considered significant.

Table 2 Comparison of HR (beat/minute) between the studied groups at different measuring points

HR	***Group I*** **(N=20)**	***Group II*** **(N=20)**	**T**	**P**
Baseline	95.7±13.7	97.9±15.1	-0.414	0.681
after induction	92.5±20.74	97.45±20.7	-0.906	0.371
5mins after intubation	87.0±16.35	94.55±22.85	-1.361	0.182
10mins after intubation	85.05±16.1	87.85±19.09	-0.322	0.749
15mins after intubation	105.6±18.5*	85.55±17.2	3.012	0.005
30mins after intubation	96.35±17.6	85.95±19.9	1.243	0.222
45mins after intubation	94.6±19.9	86.1±17.5	1.094	0.281
60mins after intubation	95.3±18.9	88.35±19.4	1.145	0.260
90mins after intubation	97.3±16.9	90.7±18.6	0.995	0.326
On extubation	116.6±13.8	103.95±18.5	1.868	0.069
10mins after extubation	95.0±17.7	94.3±16.7	0.303	0.764

Data were presented as mean and SD.
P <0.05 is considered significant.

Table 3 Comparison of MAP (mmHg) between the studied groups at different measuring points

MAP	***Group I*** **(N=20)**	***Group II*** **(N=20)**	**T**	**P**
Baseline	92.57±15.7	91.15±10.7	-0.141	0.889
after induction	69.9±12.16	71.45±15.7	-0.573	0.570
5mins after intubation	76.9±10.6	71.65±12.69	1.390	0.173
10mins after intubation	83.0±13.7*	70.25±13.83	2.690	0.011
15mins after intubation	98.9±16.07*	72.6±13.3	5.197	0.00
30mins after intubation	89.95±15.4*	71.55±16.2	3.473	0.001
45mins after intubation	87.6±16.5*	75.05±13.8	2.396	0.022
60mins after intubation	89.05±15.2*	73.35±10.5	3.301	0.002
90mins after intubation	92.6±13.9*	78.7±11.3	2.461	0.019
on extubation	115.8±14.4*	95.7±9.7	4.389	0.00
10mins after extubation	91.55±16.13	83.35±9.7	1.920	0.062

Data were presented as mean and SD.
P < 0.05 is considered significant.

Table 4 Comparison of anesthetic and analgesic requirements between the studied groups

Parameter	***Group I*****(N=20)**	***Group II*** **(N=20)**	**T**	**P**
maximum % of inhaled isoflurane	1.85±0.35*	1.24±0.25	6.201	0.00
Total supplemental fentanyl (ug)	100 (50-200) *	50 (50-100)	-2.228	0.026

Data were presented as mean and SD.
P <0.05 is considered significant.

Table 5 Comparison between the studied groups regarding recovery profile and PACU stay

Parameter	***Group I* (N=20)**	***Group II* (N=20)**	**T**	**P**
Time to extubation (mins)	19.7±5.6*	14.6±2.94	3.338	0.002
Time to PACU discharge	25.8±9.16*	12.8±4.3	5.603	0.00
PACU stay (mins)	37.5±11.1*	19.4±4.2	6.582	0.00

Data were presented as mean and SD.
P <0.05 is considered significant.

Table (6): Comparison between the studied groups regarding incidence of hypotension and bradycardia

Parameter	***Group I*(N=20)**	***Group II*(N=20)**	**X^2**	**P**
Hypotension	7(35.0%)	16(80.0%)*	8.75	0.013
Bradycardia	4(20.0%)	7(35.0%)	1.6	0.44

Data were presented as number and percentage.
P <0.05 is considered significant.

Table (7): Comparison between the studied groups regarding VAS score of pain and total postoperative analgesic requirements

Parameter	***Group I*(N=20)**	***Group II*** **(N=20)**	**T**	**P**
10 mins after extubation	6.85 ±1.3*	2.15± 1.136	12.125	0.00
30 mins after extubation	6.45 ±1.05 *	2.55±1.468	9.663	0.00
60 mins after extubation	5.45 ±1.35 *	3.65±1.565	3.887	0.00
4hours after extubation	4.9 ±1.07 *	3.75±0.966	3.565	0.001
8hours after extubation	5.15±1.03 *	3.05±0.944	6.685	0.00
12hours after extubation	4.85±1.089*	2.45±1.276	6.396	0.00
24hours after extubation	3.8±0.768 *	1.4±0.502	11.696	0.00
Total nalbufen requirement (mg)	21.0±8.5*	13.75±3.98	6.766	0.002

Data were presented as mean and SD.
P <0.05 is considered significant.

DISCUSSION

The current study demonstrated that the concurrent administration of epidural local anesthetic agents along with general anesthesia (combined general/epidural anesthesia (CGEA)) can improve patient recovery after spine surgery as evidenced by shorter time to extubation and time to PACU discharge as well as it can reduce intraoperative MAP and anesthetic requirements compared to general anesthesia alone. These beneficial effects were on expense of higher incidence of hypotension in CGEA group.

CGEA has several advantages including reduction of surgical stress, postoperative analgesia along with reduced risk of cardiac dysrhythmia, deep vein thrombosis and other cardiovascular and ischemic events. Thus this technique can reduce morbidity and enhanced patient recovery [(5)(6)].

Only few studies evaluated the efficacy of combined epidural and general anesthesia in improving recovery of patients undergoing lumbar spine surgeries [9][10][11].

In our study there was no statistically significant difference between all groups regarding surgery time and anesthesia time. This comes in agreement with a study conducted by Attari et al (2011) [12].

There was no significant difference regarding average intraoperative HR and incidence of bradycardia between both groups at most measuring points. This finding is in agreement with that of Suryavanshi et al (2016) who showed no statistically significant difference in HR between CGEA and control groups at all measuring points during the 1st intraoperative hour [13].On the other hand Khajavi et al (2013) found that the mean intraoperative HR was significantly higher in the GA group as compared with the CEG group with higher incidence of bradycardia in of the CEG group. The difference may be due to different local anesthetic dose used in Khajavi et al (2013) study [9].

In the present study, patients of group I continued to have significantly higher MAP than these recorded in group II of patients at most of intraoperative measuring points. Previous studies had also observed that intraoperatively MAP was significantly lower in the CGEA group than that in the GA group [14][15].

From our results, it is clear that Group I required significantly higher maximum percentage of isoflurane and total supplemental fentanyl than group II. This come in agreement with Khajavi et al (2013) who found that the mean percent of anesthetic agent (Isoflurane) that was used during surgery in the CGEA group was significantly lower in comparison with that of the GA group ($P < 0.001$)[9].

Also Pan et al (2015) found that at all measuring points, the concentration of isoflurane inhaled was significantly lower in the CGEA group than that of the GA group [14].

In the present study, there was a significant difference regarding time to extubation between GA and CGEA group. This comes in agreement with Wang et al (2017) who found that CGEA group had significantly shorter time to extubation compared with the GA group, which might have resulted from the lower dose of sevoflurane, muscle relaxants and analgesics used during the operation [16].

Depending on the discharge criteria studies concluded that PACU times may even be prolonged after regional anesthesia, especially when LA with a long duration of action have been used and discharge is allowed after sensory and motor block recovery, or hemodynamic parameters are restored [17][18][19][20].

This is contradictory to our results that Patients of group II showed significant shorter PACU stay than Patients of group I. In agreement with our results, Wang et al (2017) found that CGEA group had significantly shorter PACU stay compared with the GA group [16].

This may be due to the use of CGEA caused significant reduction of intraoperative anesthetic and analgesic requirement which improved the quality of recovery and decreased the need for PACU stay.

In our study Patients of Group I had significantly higher Visual analogue score (VAS) than those of group.

This come with agreement with Sale et al (2016) who found that CGEA Group had significant lower values of VAS score than GA group during post-operative period till 6 hours postoperative [21].

Different mechanisms can explain decreasing postoperative analgesic use in the EA. One mechanism is the preemptive effect of epidural analgesia (EA) that decreases the pain scores by preventing afferent nociceptive sensitization pathway [22]. Lower analgesic requirement after operation pointed out such an effect. The second mechanism is probably existence of some residual sensory blockade in EA group. This is due to lagging of sensory recovery behind motor recovery [23].

LIMITATIONS

1. Our study was conducted on ASA-I and II class patients, so further studies on elderly and compromised cardiac function patients are

required to recommend its use in such high risk patients.

2. Immediate post-operative neurological assessment is may not be possible in study CGE group patients due epidural anesthesia involving nerve roots involved in assessment.

3. Absence of BIS for monitoring depth of anesthesia.

CONCLUSIONS

Our study proved that the use of CGEA using single shot epidural analgesia [by bupivacaine (15 ml with 0.25% concentration)] can improve Patient's recovery in the form of shorter time to extubation, time for PACU discharge and duration of PACU stay this may be due to reduction of intraoperative anesthetic/ analgesics requirements. However these effects were on the expense of higher incidence of intraoperative hypotension

RECOMMENDATIONS

Larger studies with larger sample size and also include patients with ASA score II to IV are needed to evaluate the safety and efficacy of this protocol in patients undergoing elective lumbar spine surgeries. Further assessment of postoperative complications including newly developed neurological deficitsand hospital readmission is recommended.

Declaration of interest
The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.
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