Effects of General-epidural Anaesthesia on Haemodynamics in Patients with Myasthenia Gravis

X-Z Liu, C-W Wei, H-Y Wang, Y-H Ge, J Chen, J Wang, Y Zhang

ABSTRACT

Objective: *The current study aims to explore the effects of general-epidural anaesthesia (GEA) on the perioperative haemodynamics in patients with myasthenia gravis (MG), as well as their extubation time.*
Methods: *A total of 42 MG patients (Ossermann I–II b types) receiving elective total thymectomy were randomized into GEA (n = 20) and general anaesthesia alone (GA; n = 22) groups. Changes in their mean arterial pressure (MAP) and heart rate (HR) were recorded before anesthesia and at the time of intubation, skin incision, sternotomy and extubation. Dosages of general anaesthetics during time unit and the time of extubation and complete recovery from the ending of the operation were also recorded.*
Results: *After anaesthesia, both groups displayed increased MAPs and HRs, with those in the GA group significantly higher than those in the GEA group (*$p < 0.05$*). The total consumption of general anaesthetics in the GA group was markedly higher than that in the GEA group (*$p < 0.01$*).*
Conclusion: *The GEA group had shorter postoperative extubation and recovery time than the GA group (*$p < 0.01$*). General-epidural anaesthesia stabilizes perioperative haemodynamics, reduces the consumption of general anaesthetics and shortens extubation time. It is a feasible and ideal anaesthetic method at present.*

Keywords: Epidural anaesthesia, general anaesthesia, haemodynamics, myasthenia gravis

Efectos de la Anestesia General-epidural sobre la Hemodinámica en Pacientes con Miastenia Gravis

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RESUMEN

Objetivo: *El actual estudio persigue explorar los efectos de la anestesia general-epidural (GEA) sobre la hemodinámica perioperatoria en pacientes con miastenia gravis (MG), así como su tiempo de extubación.*
Métodos: *Un total de 42 pacientes con MG (tipos I-IIB de Ossermann) que recibieron timectomía total electiva, fueron asignados al azar a un grupo de GEA (n = 20) y a otro de anestesia general sola (GA; n = 22). Los cambios en su presión arterial media (PAM) y frecuencia cardiaca (FC) se registraron antes de la anestesia y en el momento de la intubación, incisión en la piel, esternotomía y extubación. También se registraron las dosis de anestésicos generales durante la unidad de tiempo y el momento de la extubación y la recuperación completa a partir del final de la operación.*
Resultados: *Después de la anestesia, ambos grupos mostraron aumentos de PAM y FC, siendo los del grupo GA significativamente más altos que los del grupo GEA (*$p < 0.05$*). El consumo total de anestésicos generales en el grupo de GA fue notablemente mayor que en el grupo GEA (*$p < 0.01$*).*
Conclusión: *El grupo GEA tuvo menos tiempo de extubación y recuperación postoperatoria que el grupo de GA (*$p < 0.01$*). La anestesia general-epidural estabiliza la hemodinámica perioperatoria, reduce el consumo de anestésicos generales, y acorta el tiempo de extubación. Es un método anestésico ideal y factible en la actualidad.*

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Palabras claves: Anestesia epidural, anestesia general, hemodinámica, miastenia gravis

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INTRODUCTION

Myasthenia gravis (MG) is an acquired autoimmune disease that involves the acetylcholine receptors on the postsynaptic membrane at the neuromuscular junction, manifested by neuromuscular transmission disorders which affect the function of skeletal muscle contraction. Pathologically, MG is based on the generation of acetylcholine receptor antibodies which reduce the number of acetylcholine receptors. However, the amount of acetylcholine receptor antibodies in serum does not necessarily indicate the severity of MG (1–3). Approximately 90% of MG patients are concurrent with thymoma or thymus hyperplasia. Thymectomy is one of the important approaches to MG nowadays. The primary complications caused by this approach include respiratory insufficiency which may further develop into respiratory failure, particularly in MG patients with Ossermann III and IV types. Anaesthetic methods for thymectomy have their own features of particularity, such as the unpredictability of patients' muscle relaxant reactions and their susceptibility to postoperative respiratory failure. Therefore, an agreement on a well-accepted anaesthetic method has not been reached.

Based on the aforementioned, we recruited 42 MG patients who received elective total thymectomy at our hospital between June 2008 and March 2009. The aims of this study were to explore the effects of general-epidural anaesthesia (GEA) on the perioperative haemodynamics in MG patients, as well as on extubation time.

SUBJECTS AND METHODS

A total of 42 MG patients (Ossermann I–II b types) of either gender receiving elective total thymectomy were recruited. Their ages ranged from 22 to 56 years and their weights from 46 to 78 kg. All patients met the requirements for the scoring proposed by Leventhal *et al* (4) [0–9 points] and the grading by the American Society of Anesthesiology (II–III grades). None of them displayed apparent vital organ dysfunction. The data were collected single-blind.

The patients were randomized into GEA (n = 20) and general anaesthesia alone (GA; n = 22) groups. Each patient with muscle weakness was given anaesthesia with 60 mg of pyridostigmine bromide for three or four days before anaesthesia. No significant difference with regard to age, gender, height, body weight or cardiopulmonary function was observed between the groups. This study was conducted in accordance with the Declaration of Helsinki and with approval from the Ethics Committee of Chinese PLA 309 Hospital. Written informed consent was obtained from all participants.

Anaesthesia

A venous channel connected to 500 mL of hetastarch 130/0.4 (Voluven) was established at the anaesthesia room. Each patient received a routine intravenous drip of 0.5 mg of atropine and 10 mg of dexamethasone. For the GA group, denitrogenated oxygen was provided with a mask. Anaesthesia induction was performed using 0.1–0.2 mg/kg midazolam, 2–4 μg/kg fentanyl, 1.5–2 mg/kg propofol and 0.04–0.05 mg/kg atracurium (1/5–1/4 of a routine dosage). After the induction, a tracheal surface anaesthesia was performed with 0.5% tetracaine for tracheal intubation. The endotracheal catheter was fixed and connected to an anaesthetic machine for mechanically-controlled respiration (tidal volume, 10 mL/kg; breathing frequency, 20 times min^{-1} and inspiratory/expiratory ratio, 1:2). During operation, 1.5–3% sevoflurane was inhaled continuously, 2–4 $mg \cdot kg^{-1} \cdot h^{-1}$ propofol was pumped in continuously, and fentanyl with a total volume of 4–6 μg/kg was added intermittently for anaesthesia maintenance. For the GEA group, a puncture was routinely performed between T6 and T7 for a continuous epidural anaesthesia. After the puncture was successfully performed, an epidural catheter was inserted headward (4–5 cm in depth). After the catheter was fixed, 1.33% lidocaine with a volume of 5 mL was infused to observe whether the catheter was accurately positioned for 10 minutes. Then, 15 mL of 1.33% lidocaine was infused, and the plane between T1 and T8 was measured. After no side effects were ensured, general anaesthesia induction was performed using the same method and drugs as was done for the GA group. Forty to sixty minutes later, 7 mL of 0.4% ropivacaine and 10 mg of morphine were given until the ending of the operation. Both groups received a rapid intravenous drip of 500 mL of Voluven before the anaesthesia induction.

Indices and monitoring

Electrocardiographs (ECGs), heart rate (HR), blood pressure (BP) and blood oxygen saturation (SpO_2) were continuously monitored using a DRAGER multifunctional monitor. The mean arterial pressures (MAPs) and HRs before anaesthesia (T1) and at the time of intubation (T2), skin incision (T3), sternotomy (T4), and extubation (T5) were recorded. The consumption of general anaesthetics and the time of extubation and complete recovery from the ending of the operation in both groups were also recorded.

Statistical analysis

All data are presented as means ± standard error of means ($\bar{x} \pm s$) and analysed using SPSS 16.0 software. Analysis of variance (ANOVA) was used for comparisons within groups and *t*-tests for comparisons between groups. $P < 0.05$ was considered statistically significant, and all tests were two-tailed.

RESULTS

No significant differences with regard to age, gender, height, body weight, cardiopulmonary function, operating time and

operational manner were observed between the two groups ($p > 0.05$; Table 1).

Table 1: Comparisons of the general data between groups ($\bar{x} \pm s$)

	GA group	GEA group
Age (years)	24.6 ± 10.4	25.2 ± 9.7
Gender (male/female)	12/10	10/10
Body weight (kg)	65.5 ± 11.7	64.4 ± 10.6
Body height (cm)	171.1 ± 6.7	171.3 ± 6.9
Operating time (min)	130.0 ± 21.3	129.0 ± 19.7

GA: general anaesthesia; GEA: general-epidural anaesthesia

Heart rate and mean arterial pressure

Both groups displayed higher MAPs and HRs at T2, T3, T4, and T5 than at T1. The HRs and MAPs from T2 to T5 in the GA group showed significant differences compared with those at T1 ($p < 0.05$), as well as those from T2 to T5 in the GEA group ($p < 0.05$) [Table 2].

Consumption of general anaesthetics and recovery time

The consumption of sevoflurane, fentanyl and propofol in the GEA group was noticeably less than that in the GA group ($p < 0.01$ and $p < 0.05$), whereas the consumption of atracurium did not show a significant difference between the groups. Both groups were extubated in the operating room. The GEA group showed markedly shortened time of deglutition reflex, SpO2 > 90%, less extubation, and complete recovery time compared with the GA group ($p < 0.01$; Tables 3 and 4).

DISCUSSION

Although scholars hold different views on anaesthetic methods for MG patients (5–9), recent studies have found that patients receiving intraoperative muscle relaxants have much more postoperative complications than those who do not receive such a treatment; furthermore, MG patients who do not receive muscle relaxants for intubation present good intra- and post-operative conditions (10, 11). In this study, GEA was performed for MG patients. The results showed that the MAPs

Table 2: Heart rate (HR) and mean arterial pressure (MAP) at different time points in the two groups ($\bar{x} \pm s$)

Index	Group	T1	T2	T3	T4	T5
HR (bpm)	GA	81.6 ± 12.2	94.3 ± 15.4*	96.4 ± 14.7*	95.3 ± 14.1*	98.3 ± 15.2*
	GEA	78.6 ± 10.4	80.2 ± 13.5#	79.1 ± 10.7#	80.5 ± 10.3#	84.4 ± 11.5#
MAP (kPa)	GA	12.6 ± 1.8	16.8 ± 2.6*	16.4 ± 2.4*	16.6 ± 1.8*	17.8 ± 2.7*
	GEA	12.1 ± 1.5	12.5 ± 2.3#	12.3 ± 1.2#	12.4 ± 1.3#	13.4 ± 2.4#

*$p < 0.05$ compared with T1; #$p < 0.05$ compared with the GA group
GA: general anaesthesia; GEA: general-epidural anaesthesia

Table 3: Comparisons of the general anaesthetic consumption between groups ($\bar{x} \pm s$)

Group	Sevoflurane (mac)	Fentanyl (mg)	Atracurium (mg)	Propofol (mg)
GA	1.4 ± 0.30**	0.34 ± 0.08**	2.0 ± 0.32	468.0 ± 34.0*
GEA	0.5 ± 0.12	0.08 ± 0.03	2.1 ± 0.31	312.0 ±32.0

*$p < 0.05$ and **$p < 0.01$ compared with the GEA group
GA: general anaesthesia; GEA: general-epidural anaesthesia

Table 4: Comparisons of the extubation time and complete recovery time between groups (min; $\bar{x} \pm s$)

Group	Deglutition reflex time	SpO_2 > 90% time	Extubation time	Complete recovery time
GA	17.00 ± 1.31*	21.01 ± 1.42*	31.03 ± 1.62*	39.54 ± 4.20*
GEA	5.31 ± 1.52	9.02 ± 1.58	12.05 ± 1.10	18.25 ± 2.80

*$p < 0.01$ compared with the GEA group
GA: general anaesthesia; GEA: general-epidural anaesthesia

and HRs at T2, T3, T4, and T5 in both groups increased compared with those at T1. This phenomenon was presumably caused by an increase in the excitability of sympathetic nerves due to the stimulation from intubation, skin incision and sternotomy. Such an increase further causes the release of a series of vasoactive substances, thereby resulting in increased BPs and HRs. Excessive stimulation during extubation can induce distress stimulation which leads to cardiovascular side effects. This phenomenon may be correlated with the increased release of plasma epinephrine and noradrenalin due to shallow anaesthesia, pains, and sputum aspiration, which is consistent with that reported in the literature (12–14).

In addition, this study showed that the amplitudes of the increased MAP and HR in the GEA group were noticeably lower than those in the GA group, which indicates that GEA can better guarantee intraoperative haemodynamic stability than GA. This phenomenon was caused by the fact that the sympathetic efferent nerve fibres governing the thoracic and abdominal vascular bed originate from the spinal cord between T1 and T3. A thoracic epidural anaesthesia blocks the splanchnic sympathetic nerves in this region and this sympathetic nerve blocking effect antagonizes the sympathetic-catecholamine source vasoconstriction caused by surgical stress, expands part of the vessels, and reduces the quantity of catecholamine released into blood from sympathetic nerve endings (15–17). Furthermore, the GEA group had a markedly better analgesic effect than the GA group and the latter group had to add the dosages of propofol and fentanyl and increase the concentration of inhaled sevoflurane to meet the requirements for the operation. Because the consumption of general anaesthetics in the GEA group was significantly less than that in the GA group, the extubation time and complete recovery time of the GEA group were noticeably shortened. Myasthenia gravis patients show high sensitive blocking to non-depolarizing muscular relaxants and only a small dosage (1/3–1/6 of a conventional dosage) is sufficient to meet the requirement for skelaxin (18). Itoh *et al,* and Della Rocca *et al* have also obtained similar results (19, 20). This phenomenon is presumably ascribed to damages to neuromuscular junction postsynaptic membranes and the decrease in functional cholinergic receptors. The binding of non-depolarizing muscular relaxants with neuromuscular junction postsynaptic membranes does not cause a change in membrane permeability or membranous depolarization. Therefore, non-depolarizing muscular relaxants do not intervene much in neuromuscular synapses and patients treated with them have a low incidence of postoperative complications. This study showed that the anaesthesia induction with a small dosage of atracurium (1/5–1/4 of a conventional dosage) for MG patients (I–II b types) without adding an extra dosage during the operation did not noticeably influence the respiratory function of both groups. This finding leads to a conclusion: GEA stabilizes perioperative haemodynamics, reduces the consumption of general anaesthetics and shortens extubation time; it is a feasible and ideal anaesthestic method at present.

CONCLUSION

Herein, we attempted to explore the effects of GEA on the perioperative haemodynamics in patients with myasthenia gravis, as well as their extubation time. We found that GEA can stabilize perioperative haemodynamics, reduce the consumption of general anaesthetics and simultaneously shorten extubation time. These dominant characteristics indicate that it is a feasible and ideal anaesthestic method at present.

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