A CASE OF LIFE-THREATENING ACUTE BRONCHOSPASM INDUCED BY ROUTINE REVERSAL OF NEUROMUSCULAR BLOCKADE

Radmilo Jankovic, Biljana Stosic, Dragana Djordjevic and Dragana Todorovic

Neostigmine-induced bronchospasm is extremelly rare in everyday anesthesia practice. We report a case of a life-threatening acute bronchospasm associated with a routine reversal of neuromuscular blockade in a 48-year-old man who underwent a ventral hernia repair under general anesthesia. Thirty seconds after, neostigmine was administered with the aim to reverse the rocuronium-induced neuromuscular blockade, the symptoms of severe bronchospasm occured, including increased peak inspiratory pressure, oxygen desaturation and decreased tidal volumes. Auscultation of the lungs revealed bilateral loud wheezes throughout. Bronchospasm was sucessefuly treated with high ispiratory concentrations of sevoflurane (7%), 100% oxygen, methylprednisolon and aminophylline. It is important that anesthetists are aware of the potential bronchoconstriction potency of neostigmine. Sevoflurane and glucocorticoids may be useful in the treatment of bronchospasm caused by neostigmine. *Acta Medica Medianae 2006; 45(3):53-55.*

***Key words**: bronchospasm, neostigmine, acetylcholine, muscarinic receptors*

Surgical Clinic Clinical Center of Nis

Correspondence to: Radmilo Jankovic
Surgical Clinic Clinical Center
48 dr Zoran Djindjic Street
18000 Nis, Serbia
Phone: +38118329503
E-mail: jradmilo@eunet.yu

Introduction

During general anesthesia administration, bronchospasm may have many etiologies, including the patient's intrinsic disease and mechanical, chemical or neurogenic causes. Although is possible, anticholinesterase- induced bronchospasm is extremelly rare in everyday anesthesia practice. We present a case of the life-threatening acute bronchospasm induced by routine reversal of neuromuscular blockade (NMB), successfully treated with sevoflurane, aminophylline and glucocorticoids.

Case report

A 48-year-old man underwent a ventral hernia repair during general anesthesia administration. His preoperative medical history was significant for long smoking history (30 cigaretes per day) and obesity. The patient denied any history of allergy, chronic lung diseases or use of any medications. No pulmonary function tests were done preoperatively. Anesthesia was induced with propofol 2mg·kg^{-1} and fentanyl 3 μg·kg^{-1}. A 8.5-mm ID cuffed endotracheal tube (ETT) was placed without difficulty under muscle relaxation achieved with intermittent administration of rocuronium under neuromuscular monitoring. Anesthesia was maintained with nitrous oxide, oxygen and sevoflurane (end tidal concentration stable at 2%). There were no signs of respiratory obstruction intraoperatively. The surgery proceeded uneventfully and was completed within approximately 30 min. Thirty seconds after 1 mg atropine and 2.5 mg neostigmine were administered with the aim to reverse the rocuronium induced NMB, the peak inspiratory pressure (PIP) increased suddenly from 19 - 22 mmHg to 50 - 55 mmHg with decreased tidal volumes. The O_2 saturation decreased to 72% and auscultation of the lungs revealed bilateral loud wheezes throughout. Mechanical ventilation was discontinued and the patient was ventilated by hand with 100% O_2 and 2% sevoflurane. No compression of the ETT or trachea was found. With the aim to ensure patency of the ETT, a suction catheter was passed into the ETT and there were no secretions or aspirate. The heart rate increased up dramatically from 88 to 135 beats·min^{-1}. Mean arterial pressure remained unchanged. An initial 250 mg of methylprednisolon and 5 mg·kg^{-1} aminophylline over the next 10 min were given. However, 10 minutes after, there was no improvement in symptoms. With agravated haemodynamical status, sevoflurane inhalation was increased immediately up to 7%, and aditional bolus

of 250 mg methylprednisolon was administered. The O_2 saturation increased to 96% within approximately 40 s and to 100% a few minutes later on 100% O_2 and 2.5 % sevoflurane. The patient was placed back on the ventilator and PIP decreased to 22 mmHg. Auscultation of the chest revealed clear breath sounds throughout and heart rate decreased to the patient's baseline 90 beats·min^{-1}. About 20 minutes after it was started, sevoflurane inhalation was discontinued. The patient was stable and was extubated successfully 25 min after this episode. Blood was sent for immunoglobulin E (IgE) and serum mast cell tryptase, and both values were normal: IgE-86 (IU)/mL (normal = 0 to 120 IU/mL), serum tryptase <1 ng/mL (normal = <10 ng/mL).

Discussion

Neostigmine is an anticholinesterase drug frequently used for reversal of nondepolarising NMB. The clinical features and the time of the reaction onset were highly suggestive of neostigmine- induced bronchospasm. Serum IgE and mast cell tryptase values were normal, excluding anaphylaxis as the cause of the bronchospasm. We believe that intravenous administration of neostigmine caused bronchospasm, as the result of its parasympathomimetic action. Increased release of acetylcholine(ACh) induced by anticholinesterase activity of neostigmine can contribute to increases in airway responsiveness. Neostigmine also potentiated serotonin-induced bronchoconstriction, supporting ACh release upon stimulation of serotonin (1). ACh stimulates both M_3 muscarinic receptors on the airway smooth muscle, causing contraction and bronchoconstriction, and M_2 muscarinic receptors on the nerves, decreasing further release of acetylcholine. Atropine is an anticholinergic drug widely used to reverse the muscarinic effects of neostigmine during routine reversal of NMB. However, atropine is a non-selective muscarinic antagonist, which blocks both prejunctional M_2-receptors and postjunctional M_3-receptors on the smooth muscle with equal efficacy. Therefore, it increases ACh release, which may then overcome the postjunctional blockade. This means that atropine will not be fully effective against Ach- induced bronchoconstriction (2).

Aminophylline and glucocorticoids are commonly used for the treatment of acute bronchospasm. The beneficial effects are based on anti-inflammatory properties of these medications. Glucocorticoid treatment also decreases airway responsiveness to ACh via two mechanisms: increased M_2 receptor function and increased degradation of acetylcholine by cholinesterases. Their effects are mediated by the activation of glucocorticoid receptors in target cells in the lung (3).

Volatile anesthetic agents have been reported to produce bronchodilatation in patients suffering from bronchospasm (4). Sevoflurane has a more marked ability to decrease respiratory resistance than isoflurane, halothane, or thiopental-nitrous oxide (5). In patients with positive smoking status, sevoflurane causes significant decreases in Rrs (6). Sevoflurane reduced the airway smooth muscle tone probably by inhibition of Ach release and by direct interference with the intracellular contractile processes of the airway smooth muscle cells (7).

Conclusion

It is important that anesthetists are aware of the potential bronchoconstriction potency of neostigmine. Sevoflurane and glucocorticoids may be useful in the treatment of bronchospasm caused by neostigmine.

References

1. Eum SY, Norel X, Lefort J, Labat C, Vargaftig BB, Brink C: Anaphylactic bronchoconstriction in BP2 mice: interactions between serotonin and acetylcholine. Br. J. Pharmacol 1999; 126: 312−16.
2. Fryer AD, Maclagan J: Muscarinic inhibitory receptors in pulmonary parasympathetic nerves in the guinea-pig. B. J Pharmacol 1984; 83: 973-78.
3. Jacoby DB, Yost BL, Kumaravel B. Glucocorticoid treatment increases inhibitory M2 muscarinic receptor expression and function in the airways. Am J Respir Cell Mol Biol 2001; 24: 485-91.
4. Hamanaka N, Taniguchi A, Tanigami H, Yoshiya I. Sevoflurane inhalation reduced bronchospasm after extubation. Masui 1996; 45:1131-4.
5. Rooke GA, Choi J-H, Bishop MJ: The effect of isoflurane, halothane, sevoflurane, and thiopental/nitrous oxide on respiratory system resistance after tracheal intubation. Anesthesiology 1997; 86: 1294-9.
6. Goff MJ, Arain SR, Ficke DJ, Uhrich T D, Ebert TJ. Absence of Bronchodilation during Desflurane Anesthesia: A Comparison to Sevoflurane and Thiopental. Anesthesiology 2000; 93: 404-8.
7. Yamakage M, Hirshman CA, Croxton TL. Volatile anesthetics inhibit voltage-dependent Ca^{2+} channels in porcine tracheal smooth muscle cells. Am J Physiol 1995; 268: 187-91.

PRIKAZ SLUČAJA AKUTNOG I PO ŽIVOT OPASNOG BRONHOSPAZMA PROVOCIRANOG RUTINSKOM REVERZIJOM NEUROMIŠIĆNE BLOKADE

Radmilo Janković, Biljana Stošić, Dragana Djordjević i Dragana Todorović

Bronhospazam, prouzrokovan neostigminom, izuzetno je redak u svakodnevnoj anesteziološkoj praksi. Mi prikazujemo slučaj po život opasnog akutnog bronhospazma udruženog sa rutinskom reverzijom neuromišićne blokade kod četrdesetjednogodišnjeg muškarca, koji se podvrgao operaciji kile, prednjeg trbušnog zida u opštoj anesteziji. Trideset sekundi nakon što je neostigmin primenjen, sa ciljem reverzije rokuronijumom izazvanog neoromišićnog bloka, razvili su se simptomi akutnog bronhospazma uključujući: povišeni vršni inspiratorni pritisak, kiseoničnu desaturaciju i smanjenje disajnih volumena. Auskultacijom pluća čulo se bilateralno glasno zviždanje. Bronhospazam je uspešno tretiran visokim inspiratornim koncentracijama sevoflurana (7%), čistim kiseonikom, metilprednizolonom i aminofilinom. Za anesteziologe je naročito važno da budu svesni bronhokonstriktorno provocirajućeg efekta neostigmina. Sevofluran i glukokortikoidi mogu biti od koristi u tretmanu bronhospazma izazvanog neostigminom. *Acta Medica Medianae 2006; 45(3):53-55.*

Ključne reči: *bronhospazam, neostigmin, acetilholin, muskarinski receptori*