Rev Colomb Anestesiol. 2012;40(1):75-78

Revista Colombiana de Anestesiología
Colombian Journal of Anesthesiology
www.revcolanest.com.co

Case report

General Anesthesia for C-Section. The Role of Sugammadex in the quality and safety of anesthesia. Case Report

Luis Alberto Tafur B.[a,*], *Eduardo Lema Flórez*[b]

[a] *Anesthesiologist, Hospital Universitario Evaristo García, Clínica Salud Florida. Assistant Professor, Universidad del Valle. Cali, Colombia*
[b] *Anesthesiologist, Hospital Universitario Evaristo García. Assistant Professor, Universidad del Valle. Cali, Colombia*

ARTICLE INFO

Article history:
Received: August 19, 2011
Accepted: August 30, 2011

Keywords:
Anesthesia General
Cesarean Section
Anesthesia
Neuromuscular Blocking Agents

ABSTRACT

C-section is one of the most common surgical procedures in the world, with 5% of the cases being managed under general anesthesia (7.5 million C-sections performed under general anesthesia every year). Due to its special circumstances (i.e., the patient has a full stomach, need for neuromuscular relaxation, mother-child wellbeing, the mother is expected to immediately provide care to the baby, and the procedure takes a short time), general anesthesia is a challenge in every case. This article discusses the case of a pregnant woman who required general anesthesia for an emergency C-section. The neuromuscular relaxant used was Rocuronium. The airway was secured promptly and the surgical conditions were appropriate. The procedure was finally reversed with sugammadex at a dose of 1mg/kg. The availability of new neuromuscular relaxation reversal agents contributes to safe management during anesthesia; furthermore, these agents limit the chances of a residual relaxation and allow better time control and depth of relaxation. Studies suggest sugammadex doses that will probably change with the advent of new trials, adapting them to the degree of neuromuscular relaxation obtained, and this will help to reduce costs and hence improve the availability of the drug in our ORs

Anestesia general para cesárea. Papel del sugammadex en la calidad y la seguridad del acto anestésico. Reporte de caso

RESUMEN

La cesárea es una de las intervenciones quirúrgicas más realizadas en el planeta. En el 5% de los casos se practica bajo anestesia general (7,5 millones de anestesias generales para cesárea cada año). Debido a sus requerimientos particulares (paciente con estómago lleno, necesidad de relajación neuromuscular, bienestar del binomio madre-hijo, expectativas de pronta atención del recién nacido por parte la madre y relativa corta duración del

*Corresponding author at: Carrera 1f # 58 - 50 apto 303A, Cali, Colombia.
E-mail: tafur05@hotmail.com (L.A. Tafur).

Palabras clave:
Anestesia general
Cesárea
Anestesia
Agentes Bloqueadores Neuromusculares

procedimiento) la anestesia general representa un reto en cada intervención. En este artículo se presenta el caso de una mujer gestante que requirió anestesia general para una cesárea de urgencia. Se utilizó rocuronio como relajante neuromuscular y se obtuvo un acceso rápido a la vía aérea, así como condiciones quirúrgicas adecuadas. Al final se revirtió el procedimiento con sugammadex a dosis de 1 mg/kg. El surgimiento de nuevos agentes para la reversión de la relajación neuromuscular contribuye a un manejo seguro durante el acto anestésico; además, estos agentes disminuyen la probabilidad de relajación residual y permiten un mejor control del tiempo y de la profundidad de la relajación. Los estudios sugieren dosis de sugammadex que muy probablemente cambiarán con el advenimiento de nuevos estudios, haciéndolas ajustables al grado de relajación neuromuscular que se tenga, lo cual ayudará a disminuir los costos y, por lo tanto, a aumentar la disponibilidad del medicamento en nuestros quirófanos.

Introduction

According to the World Health Organization (WHO), the proportion of children born through Cesarean Section should be less than 15%;[1] however, in the Latin American countries (Colombia is one of them) this number ranges between 20% and 40%. Out of the total number of C-sections, at least 5% are expected to be under general anesthesia, either because of a failed neuroaxis blockade or because the maternal or fetal circumstances require the use of this anesthetic technique.[2] If the hypothetical global rate of C-sections is around 10%, out of the 75 million births reported in the planet per year, 7.5 million will be surgical and of these, 350,000 will be performed under general anesthesia.

The anesthesia for a C-section procedure poses a bigger challenge to the anesthetist. In every case, the technique must be safe for both the mother and the child, and provide adequate surgical conditions, even under unrelenting conditions. These surgical conditions include an adequate neuromuscular relaxation; minimal impact on the uterine muscles and quick recovery, with the lowest possible risk for both the mother and the child.

General anesthesia requires adequate hypnosis, fast access to the airway – considering that, by definition, the pregnant mother has a full stomach – and operative conditions that facilitate a usually relatively short procedure.

Case Presentation

A 28-year old patient; second gestation, one birth. This was the patient's second term pregnancy with no relevant medical history; the umbilical cord was prolapsed and an emergency C-section was decided.

The patient in the OR weighed 70 kg, was 1.65 m tall, BP was 120/90 mmHg, heart rate 90 beats per minute and a fetal heart rate of 140 per minute.

Pre-oxygenation with facemask was started and the anesthetic induction is administered with fentanyl propofol and 42 mg of rocuronium; the patient was intubated 60 seconds after the administration of the neuromuscular relaxant. According to the Copenhagen Scale,[3] the intubating conditions were excellent and the difficult intubation scale rating was zero.[4]

The anesthesia was maintained with fentanyl and isofluorane; the expired fraction was 0.6 and the fresh gas flow was 0.4 L/min. A baby girl was born 15 minutes after the induction, with an APGAR score of 9/10 at one minute and 10/10 at 5 minutes. The procedure lasted 40 minutes, and at that time the train-of-four (TOF) monitoring indicated T3. Sugammadex at 1 mg/kg was administered, and 2 minutes later the TOF was 93%; the patient was extubated and transferred to the Post Anesthesia Care Unit (PACU) with a constant monitoring recording of 100% TOF.

Discussion

Three requirements must be met when selecting a neuromuscular relaxant for general anesthesia during a C-section: rapid onset of action, deep neuromuscular relaxation and prompt recovery. The number of options for neuromuscular relaxation is limited: succinylcholine and rocuronium. The former provides the best chance for a quick airway access; however, its short duration results in an insufficient neuromuscular relaxation.

Furthermore, two additional circumstances may further complicate the situation; one is the need to administer repeated doses of depolarizing agent. The second one is the higher prevalence of atypical cholinesterase among the obstetric population (1:2.000) as compared to the general population,in addition to a decreased in its activity (-34%),[5,6] that may result in a prolonged neuromuscular relaxation which can only be treated with basic support until the condition goes away. This means that if for one year, every patient undergoing C-section under general anesthesia receives succinylcholine as neuromuscular relaxant, 200 of them may end up in an ICU because of prolonged relaxation, with unimaginable social, emotional and economic consequences.

One option to achieve neuromuscular relaxation with this technique in the trans-operative period is to take advantage

of the neuromuscular relaxant properties of halogenated compounds; unfortunately, the relaxation properties of the inhaled agents extend into the uterine muscles, resulting in undesirable consequences for these patients.[7]

The results of an ambitious cross-sectional study on the prevalence of adverse events (AEs) in the hospitals of 5 Latin American countries – Colombia is once again one of them - were published in 2009).

The purpose of the trial was to use the knowledge about the epidemiology of AEs to promote the information that could help in the development of strategies to prevent these AEs. In terms of the prevalence of AEs by service, gynecology and surgery was 9,7% overall, while obstetrics was 8.4%, ranging from 1.4% up to a scary 24.9%.[8]

The information reported by the above mentioned trial includes the preventable AE, residual muscle relaxation can be classified into this definition, which can be undIagnosed or understimated in the PACU, due to the limited use of neuromuscular relaxation monitoring and the poor knowledge of the pharmacokinetics of the non-depolarizing neuromuscular relaxants.

Rocuronium allows for a rapid access of the airway and if properly dosed, enables an adequate muscle relaxation to perform the procedure;[9] however, since the average time for a C-section is 35 minutes, the residual relaxation is an issue to consider.

Currently, the prevalence of residual relaxation in the PACU – defined as a *TOF*<0.9 – ranges between 30% and 40%.[10,11] This would, in any case, call for both neuromuscular relaxation monitoring and the use of reversal agents of non-depolarizing relaxants in order to decrease the incidence of adverse events due to residual relaxation in the PACU.

A relevant question that needs to be answered promptly is: which is or which are the probable causes of such a high incidence of residual relaxation in the PACUs? There are three potential explanations: first, poor knowledge about the definition of residual relaxation. In the UK, for instance, a survey revealed that only 20.6% of the anesthesiologists were aware of the fact that a patient was fully recovered when the TOF was ≥0.9.[12] Second, some anesthesiologists give a high predictive value to the neuromuscular relaxation clinical tests. Cammu G. et al. found that the positive predictive value of clinical tests did not exceed 50%, and hence concluded that these tests are no substitute to the objective monitoring of neuromuscular relaxation.[13] Finally, the pharmacokinetic behavior of muscle relaxants is difficult to predict; Debaene B. et al. found residual relaxation, even 200 minutes after the administration of a single dose of rocuronium, vecuronium or atracurium.[14]

The evolution of anesthesia is not limited to the introduction of new electronic devices. The development of increasingly accurate and predictable drugs and a more comprehensive knowledge, suggest that the art of anesthesia will become a science and a technique.

The availability of new reversal agents of neuromuscular relaxation has revolutionized the use of non-depolarizing neuromuscular relaxants such as rocuronium and vecuronium. Before these reversal agents, it was unthinkable to achieve a *TOF* ≥0.9 in a patient in less than 3 minutes, regardless of the depth of the neuromuscular blockade, or the time elapsed following the administration of a reversal agent with no risk of recurarization episodes.

This effect is achieved with the use of cyclodextrins[15] – cyclic oligosaccharides differentiated into α, β, and γ, depending on the number of glycopyranosides contained therein (6, 7 and 8 units, respectively). Cyclodextrins are hydrophilic on the outside and lipophilic on the inside. This composition enables the formation of water soluble inclusion complexes that encapsulate the rocuronium and guide it until it is cleared in the urine.

In this particular case, the neuromuscular blockade was reversed using a 1 mg/kg dose of sugammadex with one T3 monitoring resulting in a satisfactory reversal.

According to the data of the Aurora study, the dose of sugammadex needed to reverse a dose of rocuronium after 3 minutes of its administration is 16 mg/kg. In the case of deep blockades (1-2 post-tetanic counts) established with the administration of rocuronium or vecuronium, the recommended dose is 4 mg/kg, while for moderate blockades with these two relaxants (T2-TOF-), the recommended dose for reversal is 2 mg/kg.[16]

Clearly, the required dose of sugammadex for reversal varies considerably, depending on the depth of the blockade. Schaller *et al*. found that the effective dose for reversing blockades with a TOF of 0.5, was 0.22 mg/kg of sugammadex.[17]

In the opinion of the authors, establishing the required dose of sugammadex for reversal of the neuromuscular blockade, based on the depth of the blockade, or based on the knowledge of the pharmacokinetic behavior of the muscle relaxant is indeed an untapped and exciting topic for research. But there is beyond any doubt the potential for reversal of the non-depolarizing muscle relaxation, regardless of the depth of the blockade and the time elapsed. This is an incredible breakthrough that offers the patient a relaxation as profound as needed and an almost immediate, predictable, safe and cost-effective recovery, for instance in the case of a C-section under general anesthesia.

Conclusion

The emergence of the new reversal agents contributes to a safe management of the patient during anesthesia because of a lower probability of residual relaxation and the absence of adverse perioperative events.

The available studies suggest dosages of sugammadex that will most likely change as new trials emerge that take into consideration the plasma concentration of the neuromuscular relaxant, its correlation with the depth of the relaxation measured by TOF and the determination of the dose of the reversal agent based on such concentration.

Competing Interests

None declared.

Funding sources: The authors' own resources.

REFERENCES

1. Belizán JM, Althabe F, Barros FC, et al. Rates and implications of caesarean sections in Latin America: ecological study. BMJ. 1999;319:1397-400.
2. King H, Ashley S, Brathwaite D, et al. Adequacy of general anesthesia for cesarean section. Anesth Analg. 1993;77:84-8.
3. Viby-Mogensen J, Engbaek J, Eriksson LI, et al. Good clinical research practice (GCRP) in pharmacodynamic studies of neuro-muscular blocking agents. Acta Anaesthesiol Scand. 1996;40:59-74.
4. Adnet F, Borron SW, Racine SX, et al. The intubation difficulty scale (IDS). Proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anesthesiology. 1997;87:1290-7.
5. Somers R, Jacquemyn Y, Sermeus L, et al. Corrected scoliosis, cholinesterase deficiency, and cesarean section: a case report. Case Report Med. 2009;2009:957479.
6. Guay J, Grenier Y, Varin F. Clinical pharmacokinetics of neuromuscular relaxants in pregnancy. Clin Pharmacokinet. 1998;34:483.
7. Andrews WW, Ramin SM, Maberry MC, et al. Effect of type of anesthesia on blood loss at elective repeat cesarean section. Am J Perinatol. 1992;9:197-200.
8. España. Ministerio de Sanidad y Política Social. Estudio IBEAS: Prevalencia de Efectos Adversos en Hospitales de Latinoamérica. Madrid: Ministerio de Sanidad y Política Social; 2009.
9. Abu-Halaweh SA, Massad IM, Abu-Ali HM, et al. Rapid sequence induction and intubation with 1 mg/kg rocuronium bromide in cesarean section, comparison with suxamethonium. Saudi Med J. 2007;28:1393-6.
10. Murphy GS. Residual neuromuscular blockade: incidence, assessment, and relevance in the postoperative period. Minerva Anestesiol. 2006;72:97-109.
11. Plaud B, Debaene B, Donati F, et al. Residual paralysis after emergence from anesthesia. Anesthesiology. 2010;112: 1013-22.
12. Grayling M, Sweeney BP. Recovery from neuromuscular blockade: a survey of practice. Anaesthesia. 2007;62:806-9.
13. Cammu G, De Witte J, De Veylder J, et al. Postoperative residual paralysis in outpatients versus inpatients. Anesth Analg. 2006;102:426-9.
14. Debaene B, Plaud B, Dilly MP, et al. Residual paralysis in the PACU after a single intubating dose of nondepolarizing muscle relaxant with an intermediate duration of action. Anesthesiology. 2003;98:1042-8.
15. Davis ME, Brewster ME. Cyclodextrin-based pharmaceutics: past, present and future. Nat Rev Drug Discov. 2004;3:1023-35.
16. Álvarez Gómez JA, et al. Reversal of vecuronium-induced moderate neuromuscular blockade is significantly faster with sugammadex compared with neostigmine. Results from the AURORA trial. Poster presented at the European Society of Anaesthesiology, 9-12 June 2007, Munich, Germany.
17. Schaller SJ, Fink H, Ulm K, et al. Sugammadex and neostigmine dose-finding study for reversal of shallow residual neuromuscular block. Anesthesiology. 2010;113:1054-60.