

Incidence and risk factors for postoperative residual paralysis

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Abbreviations:

NMBD: neuromuscular blocking drug

PORP: postoperative residual paralysis

TOF: train-of-four

PACU: post anesthesia care unit

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SUMMARY

Background: Several studies have shown that neuromuscular block often persists in the recovery room even after the administration of acetyl cholinesterase inhibitors. This postoperative residual neuromuscular paralysis (PORP) may represent serious safety concerns, resulting in respiratory events like muscle weakness, desaturation, pulmonary collapse and acute respiratory failure⁽¹⁾.

Methods: We studied 50 patients who underwent general anesthesia and where the neuromuscular blocking agent was used, in order to determine the incidence of PORP in our institution. **Results:** The incidence of PORP at our hospital was of 14% (seven out of fifty patients presented train of four < 0.7). The group most frequently associated with PORP was the group that received rocuronium. Surprisingly the use of neuromuscular monitoring both in the operating room and the recovery room remains very limited. **Conclusions:** Although our anesthesiologists are aware of mechanism of action and secure doses of neuromuscular blocking drug (NMBD), we still found presence of residual paralysis in our hospital. Given that PORP is a potentially preventable patient safety problem, it is important to find ways to reduce its incidence.

Key words: Neuromuscular blocking agent, postoperative residual paralysis, antagonism, train of four.

RESUMEN

Introducción: Múltiples estudios han demostrado que el bloqueo neuromuscular persiste en la unidad de cuidados postanestésicos aun después de la administración de inhibidores de acetilcolinesterasa. La parálisis residual postoperatoria puede representar serios problemas de seguridad para el paciente, incluyendo problemas respiratorios graves como lo son debilidad muscular, desaturación, colapso pulmonar y falla respiratoria aguda⁽¹⁾. **Métodos:** Se estudiaron 50 pacientes que recibieron anestesia general y donde se utilizó algún tipo de relajante neuromuscular no depolarizante. La finalidad fue determinar la incidencia de parálisis residual postoperatoria (PRPO) en nuestra Institución. **Resultados:** La incidencia de PRPO en nuestro hospital fue de 14% (siete de cincuenta pacientes presentaron tren de cuatro <0.7). El grupo que se asoció con mayor frecuencia de PRPO fue el grupo que recibió rocuronio. En nuestro medio, el uso de monitoreo neuromuscular tanto en la sala de operaciones como en recuperación, aún permanece muy limitado. **Conclusiones:** Aunque nuestros anestesiólogos están conscientes del adecuado uso de relajantes neuromusculares y de los diferentes mecanismos de acción de los mismos, hemos logrado encontrar un porcentaje considerable de PRPO en nuestro hospital. Tomando en cuenta que la parálisis residual postoperatoria es un problema de seguridad para el paciente potencialmente prevenible, es muy importante encontrar maneras de reducir su incidencia.

Palabras clave: relajantes neuromusculares, parálisis residual post operatoria, antagonismo, tren de cuatro.

INTRODUCTION

In 1942, Griffith and Johnson suggested that *d*-tubocurarine (dTc) is a safe drug to use during surgery to provide skeletal muscle relaxation⁽²⁾. In 1954, Beecher and Todd reported a six fold increase in mortality in patients receiving dTc in comparison with those who had not received a relaxant. The increased mortality was due to a general lack of understanding of the pharmacology of neuromuscular blockers and their antagonism⁽³⁾. In 1995 Baillard et al found that 33% of patients at post anesthesia care unit (PACU) had a train-of-four (TOF) ratio below 0.7⁽⁴⁾. A TOF below 0.7 was formerly considered an indicator for residual paralysis. At the present time values above 0.9 or even 1.0 are searched in order to define absence of PORP. Although the safety of general anesthesia has improved markedly over the past half century including that anesthesiologists are considered as physicians providing lifeline of modern medicine, morbidity continues to be reported. In a study conducted by Murphy et al, the incidence of critical respiratory events that occurred during patient's admission to PACU was significant (0.8%) and attributable to the use of neuromuscular blocking drugs (NMBD)⁽⁵⁾. The use of objective neuromuscular monitoring with TOF during patient's stay at PACU seems reasonable in order to detect and treat postoperative residual paralysis.

OBJECTIVE

The goal of this study was to quantify the incidence of postoperative residual paralysis after the patient's arrival to the post anesthesia care unit with the use of a neuromuscular monitor train of four.

METHODS

A prospective, observational and transversal study was conducted during July and August 2009 in a two-hundred bed university hospital in Mexico City. Fifty patients receiving an intermediate-acting neuromuscular blocking agent during general anesthesia for a scheduled surgical procedure (orthopedic, abdominal, thoracic, ear-nose-throat, or vascular surgery) were prospectively evaluated previous informed consent obtained. The choice of drugs used for pre-medication and anesthesia was at the discretion of the anesthesiologist. At the end of the procedure the train of four (TOF) ratio was registered immediately before the tracheal extubation by an investigator not involved in the anesthetic management of the patient. PORP was considered to be present if the TOF ratio was less than 0.7. The incidence of PORP was determined as a percentage, and nine clinical variables possibly related were studied

with chi square and the Fisher test for categorical values and the t student for continuous values. A *p* value < 0.05 was considered statistically significant. A SPSS program version 10 was utilized.

RESULTS

Seven out of fifty patients (14%) had PORP; 23 (46%) were men and 27 (54%) women. The mean age for the group with PORP was 72.07 ± 13.69 and 63.1 ± 15.76 years for the group without PORP. Trans anesthetic TOF monitoring was utilized in only 6 patients (12%). Forty seven patients (94%) had a physical status 1 or 2 according to the ASA classification, and no correlation was found between the ASA status and the presence of PORP (*p*: 0.786). The mean duration of anesthesia was 185.81 (SD 151.43) minutes in the group with PORP and 151.43 (SD 51.02) minutes in the group without PORP (*p*: 0.505) (Table I). Most frequently used NMBD in our study were rocuronium, vecuronium and atracurium (Figure 1). Thirty one patients (62%) received rocuronium, in this group, seven patients presented PORP (Figure 2). Nineteen patients received a different neuromuscular blocking drug and only two patients in this group had PORP (*p* 0.041). The total dose of rocuronium in the group with PORP was 42.58 ± 12.73 mg and 38.91 ± 11.28 mg in the group without PORP (*p*: 0.553).

Table I. Characteristics of the patients

Characteristics	TOF < 0.7	TOF > 0.7	p
Gender			
• Male	3	20	
• Female	4	23	
Age (years)	72.07 ± 13.69	63.1 ± 15.76	
ASA physical status			
I	3	23	
II	4	17	0.786
III		2	
IV		1	
Weight (kg)	63.15	62.07	
Height (cm)	160.35	165.70	
Duration of anaesthesia (min)	185.81 ± 151.43	151.43 ± 51.02	0.505
Use of TOF intraoperatively	2	4	
Type of NMBD			
• rocuronium	5	26	0.041
• other	2	19	
Total dosis of rocuronium (mg)	42.58 ± 12.73	38.91 ± 11.28	0.553

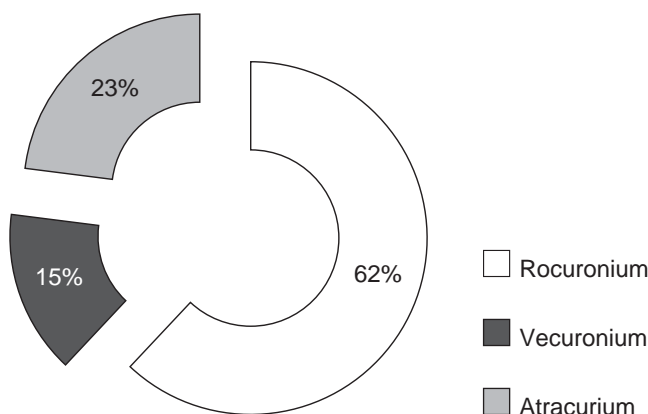


Figure 1. Type and frequency of neuromuscular blocking drug used.

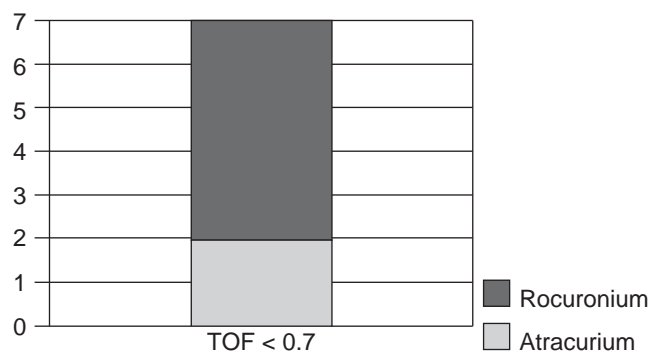


Figure 2. Post-operative residual paralysis according to NMBD used.

DISCUSSION

In this study we found that the frequency of PORP was higher when rocuronium was utilized. The incidence of PORP was 14 % in this small sample of patients and contrasts sharply with other reports (Figure 3)⁽⁶⁾. Still in any of these cases the PORP had been suspected by the attending anesthesiologist. Hayes and colleagues studied the frequency of PORP in the PACU between patients who received vecuronium, atracurium or rocuronium⁽⁷⁾. They discovered that overall incidence was 52% with no statistical difference between relaxants.

In our study, a larger number of patients with PORP could have been found if more strict criteria (TOF ratio of 0.9) would have been employed. In patients with worse physical status the incidence of PORP most probably is higher, and its clinical consequences very serious if it remains unrecognized. Usual risk factors of residual neuromuscular block such as

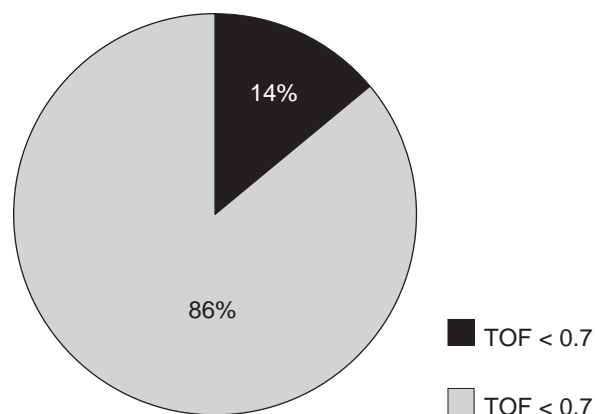


Figure 3. Incidence of post-operative residual paralysis.

the lack of monitoring and reversal of NMB agents in the operating room have been identified⁽⁸⁾. If concentrations of blocking drug at the neuromuscular nicotinic receptors are high enough, recovery will be incomplete. Future progress in achieving rapid return of neuromuscular function will probably result from some form of «chemical reversal» of residual block⁽⁹⁾. Binding of free drug molecules in plasma such as the encapsulation of rocuronium by sugammadex is one such example^(10,11). Although this drug has the potential to virtually eliminate PORP from our recovery rooms, it is still not available in our country.

Surveys of clinical practice in Europe suggest that neuromuscular blockers are often administered without proper monitoring. Surveys in Denmark, Germany, the United Kingdom, and Mexico have suggested that only 43%, 28%, 10%, and 2% of clinicians, respectively, routinely use neuromuscular monitors of any kind⁽⁶⁾. In the survey conducted by Nava-Ocampo et al of the 282 respondents, 277 (98.2%) have never used any neuromuscular monitor and the reason for this is probably that only 7.8% knew which method was considered a gold standard for neuromuscular monitoring⁽¹²⁾.

CONCLUSIONS

The «local» incidence of postoperative residual neuromuscular block within an institution is frequently unknown and confounding factors during anesthesia recovery may result in an underestimation of the morbidity related to postoperative residual neuromuscular block. Because practice guidelines are not always followed, postoperative residual neuromuscular block is still an existing concern in the PACU. If clinical signs for residual paralysis are present at PACU, we recommend use of neuromuscular monitor as a routinely procedure.

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