SHORT COMMUNICATION

COMPARISON OF DURATION OF NEUROMUSCULAR BLOCKADE WITH ATRACURIUM IN OBESE PATIENTS

Sabir Khan, Aamir Furqan*, Ahmad Farooq, Kashif Mumtaz, Shahida Khawaja, Arshad Taqi**

National Hospital and Medical Center Lahore Pakistan, *Nishter Institute of Dentistry and Medical College Multan Pakistan, **Hameed Latif Hospital Lahore Pakistan

ABSTRACT

Objective: To compare the mean duration of atracurium induced neuromuscular blockade in minutes when dosed according to real body weight (RBW) or ideal body weight (IBW) to obese patients undergoing abdominal surgeries under general anesthesia.

Study Design: Randomized controlled trial.

Place and Duration of Study: Department of Anesthesiology, National hospital defense Lahore, From March 2015 to March 2016.

Material and Methods: One hundred and fifty (150) patients were selected for this study and divided in to two equal groups (75 patients in each group), group-I (experimental group) and group-II (control group). Sample size was calculated with 80% power of test, 95% confidence interval taking mean and standard deviation of duration of atracurium induced neuromuscular blockade in minutes in both groups i.e. 74.6 ± 37.56 in real body weight group versus 40.02 ± 22.5 in ideal body weight group. Non probability consecutive sampling technique was used. SPSS version 16 was used for data analysis. Frequency and percentages were used to present categorical data and mean ± standard deviation for numerical data. Independent sample t-test was applied to compare the significance of outcome variables. A *p*-value of <0.05 was considered statistically significant.

Results: There was a prolong duration of action in experimental group (real body weight group) 69.64 ± 3.11 minute versus 46.33 ± 2.77 minute in control group (ideal body weight group) which suggests that dose of atracurium should be calculated and given on basis of ideal body weight in obese.

Conclusion: It was observed in our clinical trial that body weight calculation and dosage of atracurium accordingly has altered duration for recovery from blockade, the results of the study showed that atracurium when used according to ideal body weight as compared to total body weight has reduced duration of action. So atracurium dose should be calculated according to ideal body weight rather than total body weight in obese patients.

Keywords: Atracurium, General anesthesia, Ideal body weight, Neuromuscular blockade.

INTRODUCTION

Obesity is a disease in which excess body fat has accumulated to the level that it may have a harmful effect on health[1]. People are generally considered obese when their body mass index (BMI), a value obtained by dividing someone's weight by the square of the person's height, is over 30 kg/m^2, with the range 25–30 kg/m^2 defined as overweight[1]. Approximately every one person after seven is obese in USA[2]. Approximately 78 million adults above age 20 (37.5 million male and 40.6 million female) and 12.5 million kids and adolescents (5.5 million boys and 7 million girls) in the United States are obese. In 2009-2010, the reduction in obesity among men and women was almost 36%[3]. In a 2016 position statement, the American Association of Clinical Endocrinologists and the American College of Endocrinology proposed a new name for obesity, adiposity-based chronic disease (ABCD). These two organizations did not introduce the term as a replacement for the name obesity but rather as a means of helping the medical community focus on the pathophysiologic impact of excess weight[4]. The health risks due to obesity include cardiovascular

Correspondence: Dr Aamir Furqan, Room No # 417 Qasim Hall Nishtar Hostel Multan Pakistan *(Email: draamir2009@hotmail.com)*
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diseases, diabetes, osteoarthritis and some sex hormone sensitive cancers[5]. Similarly before surgery when a muscle relaxant is given to attain proper intubation than at the time of recovery muscles must be recovered as their natural position for adequate respiration. Achievement of fully recovered muscles is more important in obese patients because they are at high risk of apnea and inadequate saturation. Obesity has a big influence on volume distribution of medicine. Now these days decision about exact dose of medicine in obese patients is a serious issue, close monitoring is advised for safe medication in obese patients[6]. Increases in perfusion to the gut and accelerated gastric emptying may enhance the rate and extent of drug availability in obesity[7]. Calculation of doses on basis of body weight may cause some complications such as prolonged duration of action and hypersensitivity due to release of histamine[8]. In our area atracurium is most commonly used muscle relaxant, so it would be essential to calculate its dose on real basis in obese patients. Atracurium is a non-depolarizing skeletal muscle relaxant and cholinergic antagonist. It is observed that rapid administration of atracurium may cause bronchospasm[9,10] and hypersensitivity (histamine release)[11]. A previous study conducted between two groups of rocronium, in group-I rocronium given was calculated with total body weight and in group-II atracurium given was calculated with ideal body weight. It is observed that onset of action is more quick and duration of muscle relaxation was doubled in group-II (ideal body weight)[12] as compared to group-I (total body weight). For the purpose of safety and efficacy, dosing according to weight is needed for particular population and also specified in prescribing information for many medications.

After administration of muscle relaxant for intubation, in the time of recovery muscle strength must be fully recovered for normal spontaneous breathing. A more important thing in this aspect is that whether a high dose is needed in morbidly obese subjects, if yes than how can we calculate the dose of relaxant on basis of increasing body weight.

Therefore, the aim of this randomized control trial is to compare the mean duration of Atracurium-induced neuromuscular blockade in minutes when dosed according to real body weight (RBW) or ideal body weight (IBW) to obese patients undergoing abdominal surgeries under general anesthesia.

MATERIAL AND METHODS

This randomized control trial was conducted in the department of Anesthesiology, National Hospital Defense Lahore, from Machr 2015 to March 2016, after obtaining informed consent and approval from the ethical committee of this hospital, 150 patients fulfilling the inclusion criteria were recruited after preoperative assessment. The demographic information like age, sex, weight and height were recorded. The patients were randomly allocated in two groups I & II using draw box method. Sample size was calculated with 80% power of test, 95% confidence interval taking mean and standard deviation of duration of atracurium induced neuromuscular blockade in minutes in both groups i.e. 74.6 ± 37.56 in real body weight groups versus 40.02 ± 22.5 in ideal body weight group. Non probability consecutive sampling technique was used. Patients with renal or hepatic diseases anticipated difficult intubation, neuromuscular diseases and history of drug allergies previously were excluded from the study. In group-I (experimental group), atracurium was given according to real body weight. In group-II (control group), atracurium was given according to ideal body weight. The dose of muscle relaxant was filled in syringes and the anesthetist was blinded to the group. All the patients were pre-medicated with intravenous midazolam 0.02 mg/kg before shifting to operating room.

Two surface electrodes were placed on Ulnar nerve at wrist joint in the beginning of procedure. Neuromuscular paralysis was monitored using train of four visual responses (TOF). Induction

was done with intravenous propofol 2mg/kg and atracurium 0.5mg/kg was used for paralysis. Maintenance was done using isoflorane in 100% oxygen. In operating room, heart rate, blood pressure, oxygen saturation and ECG were continuously monitored by the same anesthetist by electronic monitors till patients shifted to postoperative anesthesia care unit.

TOF response was noted every 1 minute for first 5 minutes starting with the administration of atracurium. Thereafter, it was monitored every 5 minutes till third twitch reappears. Duration of action was completed with the appearance of T3.

The time of administration of atracurium, disappearance of first twitch (onset of action) and time of reappearance of third twitch (duration of action) was noted on Performa.

All the collected data were entered in SPSS version 19 and analyzed. The variables analyzed included demographic (age, sex, weight, height, ideal body weight) and duration of action (in minutes). Chi-square test was used to compare the groups for proportions of different types of surgeries. The quantitative data e.g. duration of action (in minutes) was calculated through mean and standard deviation. Independent sample t-test was applied to compare the significance of outcome variables e.g. duration of action (in minutes), A *p*-value of <0.05 was considered statistically significant.

RESULTS

A total of 150 patients fulfilling the inclusion/exclusion criteria were enrolled to compare the mean duration of atracurium-induced neuromuscular blockade in minutes when dosed according to real body weight (RBW) or ideal body weight (IBW) to obese patients selected for abdominal surgeries under GA.

Mean age of patients in group-I was 35.66 ± 4.58years and in group-II was 33.42 ± 4.40years. Gender distribution of the patients show 64% (n=48) in group-I and 68% (n=51) in group-II were females while rest of the patients in both groups were males (table-I).

Table-I: Demographic variable.

	Group-1 (Experimental group) (n=75)	Group-2 (Control group) (n=75)	*p*-value
Age in years	35.66 ± 4.58	33.42 ± 4.40	0.153
Mean Body Mass Index	32.54 ± 3.76	33.62 ± 4.22	<0.001
Female	48 (64%)	51 (68%)	<0.001
Male	27 (36%)	24 (32%)	

Table-II: Mean duration of action.

	Group-1 (Experimental group) (n=75)	Group-2 (Control group)(n=75)	*p*-value
Mean Duration of Action (in minutes)	69.64 ± 3.11	46.33 ± 2.77	0.001

Body mass index of the patients was calculated, it shows 32.54 ± 3.76 in group-I and 33.62 ± 4.22 in group-II (table-I).

Duration of action of drug was 69.64 ± 3.11 minutes and 46.33 ± 2.77 minutes respectively showing significant difference (*p*-value 0.001) (table-II). Duration of action showing also significant difference with mean BMI and gender (*p*-values <0.001 and <0.001 respectively), but showing not significantly difference with age as (*p*-value 0.153) (table-I).

DISCUSSION

Atracurium is neuromuscular blocking agent whose elimination is not dependent on kidney and liver function Ingrande et al. scaled the induction dose of propofol to lean body weight

(LBW) or total body weight (TBW) in 60 morbidly obese (MO) patients and compared dosing with a control group of 30 non-obese subjects receiving propofol scaled to total body weight. The results confirmed that LBW is a more appropriate dosing scalar for the induction dose of propofol morbidly obese patients and that LBW assessed by BIA is in good agreement with the equations of Janmahasatian[12]. The use of atracuriumon basis of ideal body weight has been shown to be associated with a more certain muscle effort recovery within 60 minutes and a lack of need for antagonism compared to total body weight[13]. Many studies have been conducted for its use in fatty patients and different theories have been made for its dosing on basis of total body weight, total body mass with dose reduction (every 10 kg more than 70 kg)[14] and lean body weight[15,16]. When a muscle relaxant is used in a patient for intubation, it is necessary to recover full muscular strength of patient for spontaneous breathing at the time of recovery especially in obese patients.

Results of our study are same as in a previous study conducted by Leykin et al[17], mean duration of action was 76.4% and 45.2% in obese with respect to total and ideal body weight. There are many justifications of our results that atracurium dosed on basis of ideal body weight. Firstly it is not necessary that increase in body weight increase the muscular tissues in the body. Secondly there is a correlation between dose and effects of atracurium because of its hydrophilic nature.

In a study conducted by Kirkegaard-Neilsen et al[18] on 127 patients (mean weight 69 kg) reported that atracurium at dose of 0.5mg/kg have prolong duration of action when dosing based on total body weight. He suggested that dose of atracurium should be reduced by 2.3 mg for each 10 kg after 70 kg when used on basis of total body weight at the time induction. These two studies are in a close relation to our study which simply recommended that atracurium must be dosed on basis of ideal body weight.

Weinstein et al. conducted a study on neuromuscular blockade by atracurium at doses of 0.5m/kg on basis of total body weight in obese and non-obese patients. He studied recovery time and results of his study were mean weight 80 kg and in non-obese mean weight was 60 kg. He concluded that there is no markable difference between recovery times in both groups.

In another study by Beemer et al. on body build variables to evaluate the right method of atracurium administration and suggested that atracurium should be administered on lean body weight basis. In this study obese patients were excluded, maximum weight included in this study was 116 kg. In this study only infusion atracurium following bolus injection of succinylcholine was evaluated not bolus atracurium.

When we follow the treatment list for good and effective results in non-emergency intubation conditions in non-obese a dose of 0.4-0.5 mg/kg should be administered. By this dose a maximum blockage can be achieved within 3-5 min after administration. In clinical aspects effect of neuromuscular block lasts in 20 to 35 min when administered under balanced anaesthesia and in recovery phase more than 25% control can be achieved within an half hour and complete recovery can be achieved within 60 minutes. One of the study limitations was that we didn't observed duration of action and intubating conditions and depth of block.

CONCLUSION

It was observed in our clinical trial that body weight calculation and dosage of atracurium accordingly has altered duration for recovery from blockade, the results of the study showed that Atracurium when used according to ideal body weight as compared to total body weight has reduced duration of action. So atracurium dose should calculate according to ideal body weight rather than total body weight in obese patients.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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