Time From Giving Reversal to Train of Four 90 %: A Comparison Between Inhalational Anaesthesia and Propofol

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ABSTRACT:

BACKGROUND:

The train-of-four (TOF) ratio should return to at least 90% to exclude potentially clinically significant postoperative residual block. The time gap between clinical recovery (subjective) until objective recovery (i.e. TOF ratio has returned to _0.90) can be considered "the potentially unsafe period of recovery

OBJECTIVE:

To determine the time difference (from giving the reversal drugs till reach TOF90% readings by acceleromyography) between patients maintained on propofol and those maintained on halothane.

PATIENTS AND METHOD:

A prospective clinical trial study100 females underwent caesarian section divided into inhalational anaesthesia group (maintained on inhalational anaesthesia-halothane) and propofol group (maintained on propofol infusion after delivery of the baby till the end of operation) then recovery is monitored using acceleromyography.

RESULT:

Times from giving reversal of the muscle relaxant till extubation and time from giving reversal till reading of TOF90% were significantly lower in propofol group than in inhalational group.

CONCLUSION:

Patients maintained on propofol was extubated earlier than those maintained on inhalational anaesthesia also needed less time to reach TOF90% i.e. inhalational anaesthesia augment muscle relaxation more than propofol.

KEY WORDS: acceleromyography, train of four 90%, propofol, inhalational anaesthesia.

INTRODUCTION:

There is wide inter-individual variability regarding neuromuscular blocking drugs, thus, there are excellent theoretical reasons to monitor their effect in all patients. [(1)]

The use of anticholinesterases to reverse residual neuromuscular block is efficacious only if recovery is already established. It was originally advised that at least the second twitch (T_2) of the train-of-four response should be detectable before neostigmine is administered. [(2)]

Incomplete neuromuscular recovery may cause reduction in vital capacity and hypoxic ventilator response, as well as obstruction of the upper airway and disruption of the upper airway and disruption of the pharyngeal function.[(3)]

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Assessment of neuromuscular blockade:

A variety of methods providing an indirect measure of contractile force have been employed. These include:

1. Vision and touch.
2. Mechanomyography.
3. Acceleromyography
4. Electromyography.[(4)]
5. phonomyography [(5)]

Train-of-four stimulation:

Is a series of four twitches in 2 seconds (2 Hz frequency) each 0.2 second long. The resulting contractions give as much information as a tetanic burst, and may be repeated more frequently. It is less painful than tetanic stimulation. The ratio of the amplitude of the fourth evoked response to that of the first is used as a measure of the neuromuscular transmission. The fourth is eliminated at about 75% depression of the control, the third at 80% and the second at 90%. Absence of all four indicates complete block.

A T4/T1 ratio >60 % is equivalent to being able to raise the head from the bed and having normal respiratory function tests. A T4/T1 ratio >75% is equal to being able to cough properly, open the eyes and protrude the tongue on command.[6]

PATIENTS AND METHODS (Sample and setting):

A prospective, clinical trial study of one hundred females who underwent caesarian section under general anesthesia.

After obtaining approval from the scientific council of anesthesia and intensive care /Iraqi board the study was done in the obstetric theaters of Baghdad Teaching Hospital during a period of four months from the first of February 2012 to the first of March 2013. 100 female patients were divided into two equal groups (each 50 patients); group A (referred to as inhalational) and group B (referred to as propofol group) studied under general anaesthesia, ASA 1 (a healthy person with no systemic disease), aged 20-40 years scheduled for emergency and elective caesarian section surgeries.

Exclusion criteria:

1. Presence of neuromuscular, hepatic, renal, or cardiac disease.
2. Patient had any metabolic abnormality known to alter neuromuscular transmission.
3. Receiving any drug known or suspected of interfering with neuromuscular function.
4. Body mass index of more than 35.
5. Expected procedure duration more than 75 minutes.
6. Anticipated difficult ventilation or endotracheal intubation.
7. Receiving drugs known to interfere with neuromuscular transmission.
8. The need for extra drugs or procedures indicated during operation and not scheduled in our thesis.

A detailed history was taken from each patient, information of the past medical and surgical history. A clinical examination was performed before surgery. Right sided tilting done to all patients as they lie on the coach. All patients received the same drugs which are administered according to body weight After securing an intravenous (IV) access, intravenous induction was done by thiopental 4-5mg-kg slowly(anesthetizing dose) followed by succinylcholine 1 mg-kg followed by tracheal intubation using endotracheal tube and intermittent positive pressure ventilation. Anaesthesia is maintained using halothane 1% concentration in oxygen at the beginning of operation and non-depolarizing muscle relaxant (atracurium 0.25 mg/kg).

After the delivery of the baby (fentanyl 1µg/kg and midazolam 1 mg were given to all patients to provide analgesia and amnesia); the patients were divided randomly into two groups: group A (referred to as inhalational) maintained on halothane 0.5% concentration after the delivery of the baby till the end of the operation while group B (referred to as propofol group) were maintained on propofol infusion 50-200µg/kg/min. titrated accordingly.

Monitoring was done using electrocardiogram, SpO_2, blood pressure, and temperature monitoring using (Contron) device and an electronic thermometer. The TOF–watch (Organon, Inc., Dublin, Ireland) device connected to patient by stimulation of the ulnar nerve the electrodes are best applied at the volar side of the wrist, the distal electrode should be placed about 1 cm proximal to the point at which the proximal flexion crease of the wrist crosses the radial side of the tendon of carpi unlaris muscle. The proximal electrode preferably should placed2 to 5 cm proximal to the distal electrode, the piezoelectric ceramic wafer an acceleration transducer was taped distal to the distal interphalangeal joint of the thumb, and the study arm immobilized with a splint. The study arm was positioned to allow free movement of the thumb.

Near the end of the operation, regular electrical nerve stimulation by TOF Watch done and reversal in both groups given at T3 reading then TOF reading observed when the patient extubated meanwhile time is recorded at each step till TOF Watch read 90%or more.

The time from T3 to the TOF90% calculated for all operations and a comparison between the two groups done.

The collected data were statistically analyzed using SPSS (statistical package for social sciences) version 20. Descriptive statistics were presented as mean ± standard deviation (SD) and ranges for all variables under study. Student's test was used to compare means in between both groups and to find the significance of possible differences. Differences in means considered as significant if P value ≤ 0.05. Finally results were presented in tables and figures.

RESULTS:

In both groups the baseline characteristics of the patients (age, height, weight and body mass index) were of comparable results so there were no significant differences between the two groups as shown in table (1).

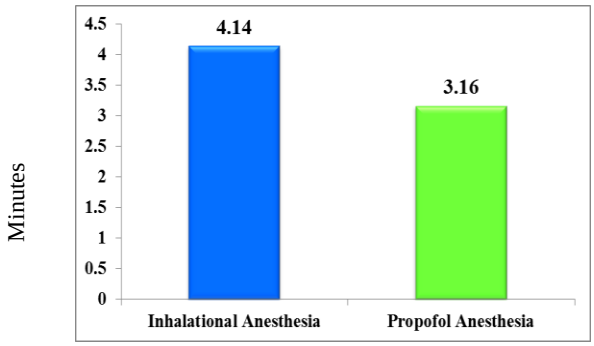
Table 1: Baseline characteristics of patients.

	Inhalational Anesthesia Mean ± SD	Propofol Anesthesia Mean ± SD	P value
Age (Years)	28.78 ± 6.95	29.46 ± 6.02	0.6 (NS)
Weight (Kg)	77.40 ± 9.38	78.00 ± 8.69	0.74 (NS)
Height (cm)	162.98 ± 5.38	164.80 ± 6.77	0.14 (NS)
BMI(kg/m^2	29.14 ± 3	28.60 ± 2.10	0.29 (NS)

There is statistical significant difference between the two groups regarding the time between giving reversal of the muscle relaxant (which determined by the appearance of T3 in the TOF watch) and extubation of the endotracheal tube (T.AD-Ext (Min)), in which it is less in the propofol group (3.16 ± 1.67) minutes than in the inhalational group(4.14 ± 1.97)minutes, p-value(0.009) as shown I table (2) and figure (1) below.

Table 2: Time distribution in patients of inhalational and propofol groups.

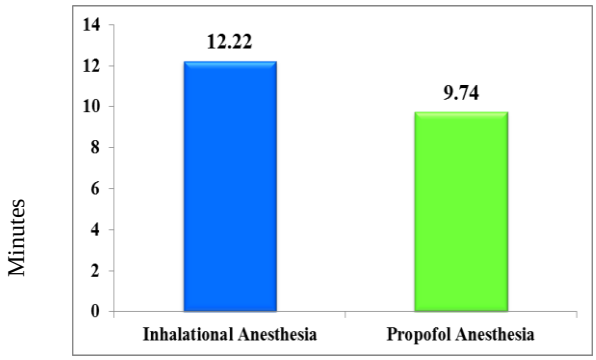
	Inhalational Anesthesia Mean ± SD	Propofol Anesthesia Mean ± SD	P value
T.AD-Ext (min.) Time from reversal-extubation	4.14 ± 1.97	3.16 ± 1.67	0.009
T.AD-TOF90%(min.) Time from reversal-TOF90%	12.22 ± 4.97	9.74 ± 4.50	0.01
TOF. Ext(min.) TOF% at extubation	31.92 ± 16.17	31.64 ± 11.47	0.92
Duration of operation(min.)	40.64 ± 9.66	48.70 ± 11.35	< 0.0001



P = 0.009, T.AD.Ext (Min)

Figure 1: Show the time from giving reversal till extubation (in minutes).

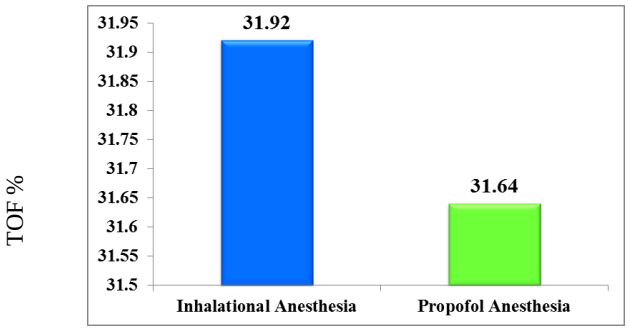
There is also statistically significant difference between the two groups regarding the time (duration) needed to reach TOF 90%(T.AD-TOF90%) where propofol group needed lesser time(9.74 ± 4.50) than the inhalational group(12.22 ± 4.97),p-value0.01 (can be explained by the inhalational augmentation of the muscle relaxation more than propofol) as shown in table (2) above and figure (2).



P = 0.01 . T.AD.90%

Fig 2: Shows time from giving the reversal till TOF 90% reading.

Regarding the TOF% reading at extubation, it was comparable in both groups so there was no difference between the two groups, although it was slightly lower in propofol group(31.64 ± 11.47)than in inhalational group(31.92 ± 16.17).p-value(0.92 (NS) as shown in table(2) above ad figure(3).



P = 0.92 (NS), TOF% .Ext

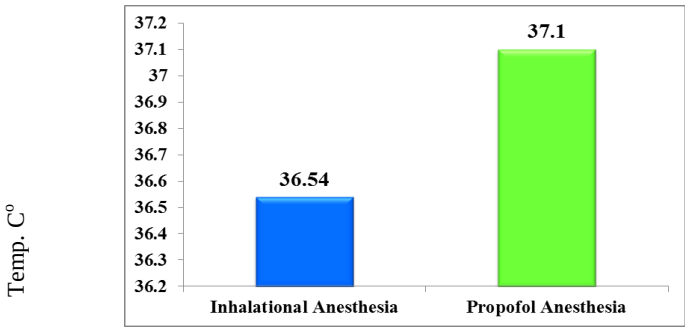
Fig 3: Shows TOF% reading at time of extubation.

Regarding the duration of the operations in both groups although the results were of significant difference between the two groups as shown in table (3) which is because the operations not performed by the same doctors (i.e of variable skills) and variation of the complexity of the different operations, but it is of no importance because in both groups the reversal was given when T3 is reached as displayed by the TOF watch.

The table (3)show that saturated Oxygen percent (SPO_2), systolic and diastolic blood pressures were comparable i.e no significant results found between the two groups, while the temperature was statistically significant higher in propofol group than in inhalational group as in figure(4). The heart rate was also significantly higher in propofol group which may be due to earlier awakening from general anaesthesia.

Table 3: Comparison of vital signs and SPO_2 between the study groups.

	Inhalational Anesthesia Mean ± SD	Propofol Anesthesia Mean ± SD	P value
Temperature at TOF 90% (˚C)	36.54 ± 0.5	37.10 ± 0.23	< 0.0001
Saturated Oxygen Percent at TOF 90%(SPO_2%)	99.32 ± 0.68	99.26 ± 0.48	0.66 (NS)
Systolic Blood Pressure at TOF 90%(mm Hg)	125.40 ± 13.64	129.10 ± 9.08	0.118 (NS)
Diastolic Blood Pressure at TOF 90%(mm Hg)	77.92 ± 10.66	78.00 ± 6.76	0.96 (NS)
Heart Rate(/min)	96.76 ± 15.50	105.52 ± 6.77	<0.0001



P = < 0.0001. Temperature at TOF 90%

Fig 4: Shows temperature of patients in both groups.

DISCUSSION:

There is statistically significant difference between the two groups regarding the time (duration) needed to reach TOF 90% (T.AD-TOF90%) where propofol group needed lesser time (9.74 ± 4.50) than the inhalational group (12.22 ± 4.97),p-value0.01 (can be explained as the inhalational anaesthetics augment the muscle relaxation more than propofol).

There is also statistical significant difference between the two groups regarding the time between giving reversal of the muscle relaxant and extubation of the endotracheal tube, where it is less in the propofol group than in the inhalatinal group p-value(0.009) (this can be explained by maintaining of anaesthesia using inhalational anaesthetic augment muscle relaxation).

Aaron F. Kopman et al [7] They found that there is no significant difference between the two groups. Their results are almost identical with results of this study regarding those patients maintained on inhalational anaesthesia [7]

Kirkegaard H, Heier T, Caldwell JE. They concluded that to achieve rapid reversal to a TOF ratio of 0.7 in more than 87% of patients, three or four tactile responses should be present at the time of neostigmine administration.[8)] ,and this was similar with our results regarding the group maintained on propofol [8]

Fuchs-Buder T et al , They concluded that low doses of neostigmine (10-30) were required to reach a TOF ratio of 0.9 within an interval of 10 minutes and recommended these doses specifically for atracurium and an intravenous anaesthetic background. And this was compatible with this study.

CONCLUSION:

Maintaining of anaesthesia using inhalational anaesthetic augment muscle relaxation more than maintenance on propofol leading to more prolonged time needed to reach TOF 90%.

Recommendation :

It is recommended to depend on objective AMG in the assessment of neuromuscular status for more safety, less postoperative complications and accurate neuromuscular function assessment (and hence safe recovery), and to give TIVA instead of inhalational anaesthesia whenever possible.

REFERENCES:

1. T E J Healy, P. J. Cohen (A practice of anaesthesia, Wylie&Churchil-Davidson, 2004:283.
2. Srivastava and J.M. Hunter, (Reversal of neuromuscular block), BJA 2009;103:115-29.
3. Meistelman C, Alla F, Grandjean A, Fuchs-Buder T, Wuthrich Y, Donati F.)(Antagonism of low degrees of atracurium-induced neuromuscular blockade: dose-effect relationship for neostigmine.),(Anesthesiology. 2010; 112:34-40.
4. Collin Pinnock, Ted Lin, Tim Smith, (fundamentals of anaesthesia), 2nd edition 2003:45.
5. Allan P. Reed, Francine S. Yudkowitz, (Clinical cases in anaesthesia),3rd edition 2005, Elseiver:134.
6. G. B. Rushman,N.J.Davies, J.N.Cashman (Lee ´s synopsis of anaesthesia),12th edition1999:206.

7. Aaron F. Kopman, Lee M. Zank, Jennifer Ng, and George G. Neuman (Antagonism of cisatracurium and rocuronium block at a tactile train-of-four count of 2: Should quantitative assessment of neuromuscular function be mandatory), Anesth Analg 2004;98:102–6.

8. Kirkegaard H, Heier T, Caldwell JE. (Efficacy of tactile-guided reversal from cisatracurium-induced neuromuscular block), Anesthesiology. 2002;96:45-50.

9. Thomas Fuchs-Buder, Claude Meistelman, ¸ ois Alla, Arnaud Grandjean, Yann Wuthrich¸ ois Donati,(Antagonism of Low Degrees of Atracurium-induced Neuromuscular Blockade Dose–Effect Relationship for Neostigmine), Anesthesiology 2010;112:34- 40.