

# Abdominal Pressure Variations and Degree of Myorelaxation During Extra Abdominal Surgery

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## Abstract

**Aim:** The purpose of the study is to verify the hypothesis that there is a correlation between the degrees of myorelaxation obtained by neuromuscular blockage during general anesthesia with changes in IAP values.

**Material and methods:** The present study was carried out in surgery department, during September 2016 - October 2016. The plot consisted of 9 patients who undergone surgeries in the extra-abdominal area: 2 total thyroidectomies, 3 subtotal thyroidectomies, 3 simple mastectomy and one axilo-femoral bypass.

**Results:** By comparing the results obtained in the nine cases, it was observed a statistically insignificant increase of intraabdominal pressure at train of four ratio values of 0, 1 or 2, intraabdominal pressure instead showed statistically significant variations in train of four ratio values of 3 or 4, observed especially at the reversal of anesthesia and patient waking up.

**Conclusions:** Train of four ratio is an accurate indicator of the degree of neuromuscular blockage. Train of four ratio values of 0-2 changed statistically insignificant the intra-abdominal pressure. Increase train of four ratio over 3 led to sudden increases in intra-abdominal pressure.

**Keywords:** Intraabdominal pressure; Neuromuscular blocking agents

## Introduction

It is well known that the intraabdominal pressure (IAP) shows very wide variations in certain physiological or pathological condition such as changing the position of standing in supine exercise, coughing, sneezing, Valsalva maneuver [1]. Thus, different studies in the literature, report abdominal pressure values between 16 mmHg, 20 mmHg in standing 25-30 mmHg during exercise to lift a weight of 5 kg and the highest values of 06 mmHg -171 mmHg was recorded during coughing, sneezing or jumping. All these states, have in common abdominal muscle contraction which will cause the default volume reduction of peritoneal cavity and increased IAP [2].

Similarly, the lack of muscle relaxation during surgeries performed either in abdominal area or extra-abdominal one it will lead to increased IAP, decreased perfusion pressure, tissue ischemia and pain [3]. The evaluation of muscle relaxation is based by measuring neuromuscular transmission speed. The effectiveness of neuromuscular transmission interruption through neuromotor blocking agents can be measured objectively by a method similar to electromyography [4]. Peripheral nerve stimulation cause muscle contraction in associated innervation territory. The train of four (TOF) ratios denotes the number of muscle contractions obtained after the launch of four peripheral nerve impulses [5]. The presence of all four contractions, translates complete absence of neuromuscular blockade and absence of any contraction means complete inhibition of neuromuscular motor plaque able to provide muscle relaxation ideal for general anesthesia with mechanical ventilation. TOF ratio degrees 1 and 2 may be present intermittently during general anesthesia, while the TOF ratio 3 degrees appear signs of patient awakening [6].

The purpose of the study is to verify the hypothesis that there is a correlation between the degrees of miorelaxation obtained by neuromuscular blockage during general anesthesia with changes in IAP values.

## Materials and Methods

The present study was carried out in the operating rooms of surgery department, during September 2016 - October 2016, in collaboration with the anesthetic team. The plot consisted of 9 patients who undergone surgeries in the extra-abdominal area: 2 total thyroidectomies, 3 subtotal thyroidectomies, 3 simple mastectomy and one axilofemoral bypass (Figure 1).

**Inclusion criteria:** The need for endotracheal intubation under general anesthesia for the condition which will be treated by surgery, surgeries in extra-abdominal area.

**Exclusion criteria:** History of peripheral nerves injuries: ulnar, sural or facial, swelling in the arms and legs, upper limb bone lesions, the presence of abdominal scars, urinary infection, comorbidities affecting neuromuscular junction: myasthenia gravis, multiple sclerosis.

Effective control of myorelaxation was performed by recording the TOF ratio. The electrodes were placed in the left forearm with ulnar nerve stimulation as a target in the following manner: the negative electrode was applied to 1 cm above the folds of the carpal region, and the positive to 3-4 cm proximal to the previous. In the tenarian region was placed the perception sensor of tetany movements, which in our

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case, is sensitive to thumb adduction, made by the thumb adductor muscle contraction (Figures 2 and 3).

During every surgery, TOF ratio values were recorded at predetermined intervals of time, so the first 8 determinations were made once at every 20 minutes, the 9<sup>th</sup> at the end of surgery and the last during patient awakening signs presence. Abdominal pressure measurement was performed using the Abviser ABV 611 kit. (Figure 4)

**Results**

By comparing the results obtained in the nine cases, it was observed a statistically insignificant increase of IAP at TOF ratio values of 0,1 or 2, IAP instead showed statistic significant variations in TOF ratio values of 3 or 4, observed especially at the reversal of anesthesia and patient waking up (Figure 5 and Table I).

**Discussions**

Neuromuscular blockers have been used for years as part of necessary medication and management of general anesthesia induction [7]. The TOF tests the degree of neuromuscular block by stimulating a peripheral nerve and tracking muscle reaction [8]. The purpose of the procedure is to ensure the anesthetist that the patient is properly dosed with neuromuscular blocking agents (NMBA) [6]. The main mechanism of action of neuromuscular blocking agents is to cease the transmission of nerve impulses in the neuromotor junction [9]. Depolarizing curare derivatives works by attaching them to the neuromuscular junction acetylcholine receptor resulting after depolarization, muscles fasciculation and then paralysis.

Since the duration of action is short, with a rapid onset, are used in endotracheal intubation followed or not by short surgical

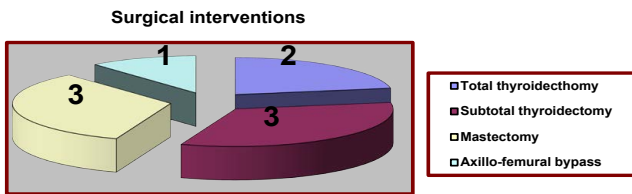


Figure 1: The type of surgery that were practiced TOF determinations.

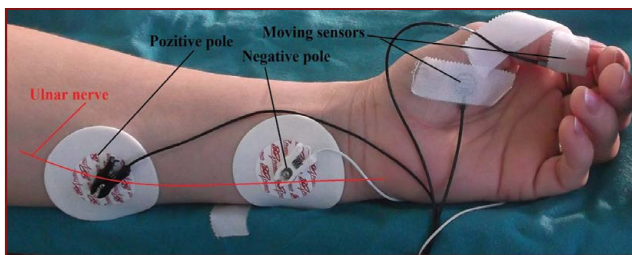


Figure 2: Placing electrodes on forearm, following the ulnar nerve path.

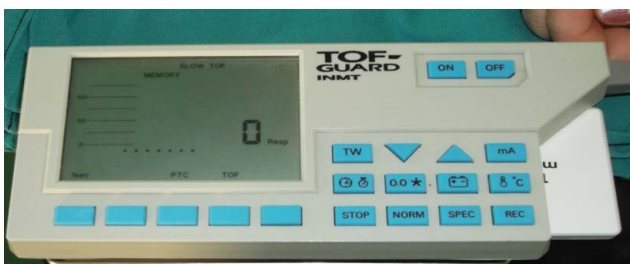


Figure 3: TOF-Guard monitor.



Figure 4: IAP pressure measurement with the transducer on the iliac crest.

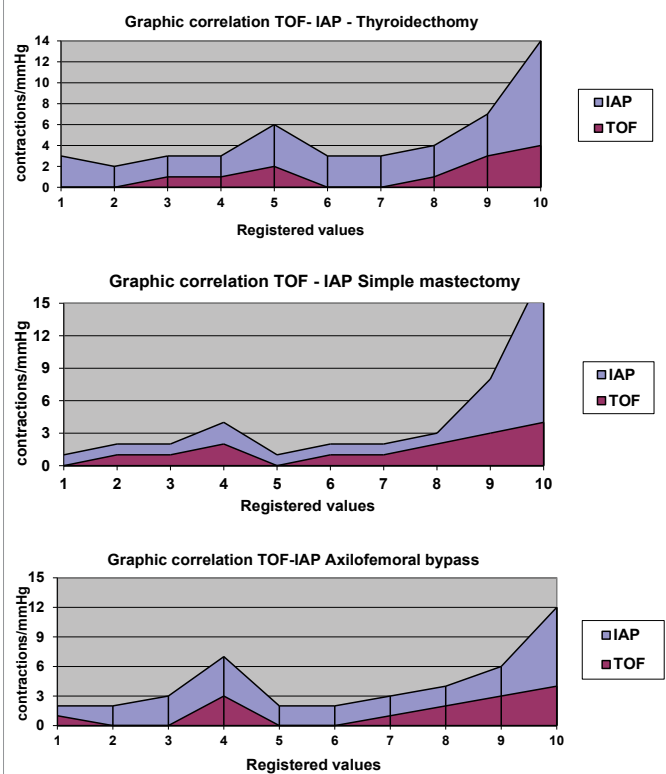


Figure 5: Variations of PIA dependent TOF ratio during different surgical procedures.

interventions. The main representative of this class is succinylcholine [10]. Non-depolarizing curare derivatives works by acetylcholine receptor occupancy, but without causing depolarization. Their action is slowly installed, instead is longer. They are used in procedures with last longer. The only action of these drugs is muscle paralysis. Therefore they must be associated with analgesic agents, hypno-inductors, under general anesthesia [10]. Improper use of neuromuscular blocking agents may produce unwanted movements, with mechanical ventilation difficulties, increases in intra-abdominal pressure, causing tissue ischemia, where under dosing or contrary, prolonged paralysis with delayed recovery, drug accumulation in the body in case of overdose [11]. TOF ratio is the most common method for monitoring the efficiency of neuromuscular blocking by stimulating peripheral nerves, completely free of complications [12]. Electrical stimulus is released over a period of 0.2 milliseconds, spaced by 500 milliseconds then ± 5% (2 Hz). This pattern of stimulation is repeated every 10 seconds.

**Table I:** Registered values of IAP and TOF ratio in the nine patients at regular time intervals.

| Surgical procedure     | IAP(mmHg) /contractions | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------------|-------------------------|---|---|---|---|---|---|---|---|---|----|
| Total thyroidectomy    | IAP                     | 2 | 2 | 1 | 4 | 1 | 2 | 2 | 3 | 5 | 10 |
|                        | TOF                     | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 1 | 2 | 3  |
| Subtotal thyroidectomy | IAP                     | 3 | 2 | 3 | 3 | 6 | 3 | 3 | 4 | 7 | 14 |
|                        | TOF                     | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 1 | 3 | 4  |
| Axilofemoral by-pass   | IAP                     | 2 | 2 | 3 | 7 | 2 | 2 | 3 | 4 | 6 | 12 |
|                        | TOF                     | 1 | 0 | 0 | 3 | 0 | 0 | 1 | 2 | 3 | 4  |
| Subtotal thyroidectomy | IAP                     | 4 | 6 | 3 | 3 | 4 | 5 | 4 | 4 | 5 | 10 |
|                        | TOF                     | 0 | 2 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 3  |
| Simple mastectomy      | IAP                     | 1 | 2 | 2 | 4 | 1 | 2 | 2 | 3 | 8 | 18 |
|                        | TOF                     | 0 | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 3 | 4  |
| Simple mastectomy      | IAP                     | 3 | 3 | 4 | 3 | 8 | 4 | 3 | 4 | 9 | 16 |
|                        | TOF                     | 1 | 1 | 0 | 0 | 3 | 0 | 0 | 1 | 3 | 4  |
| Total thyroidectomy    | IAP                     | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 4 | 7 | 15 |
|                        | TOF                     | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 2 | 3 | 4  |
| Simple mastectomy      | IAP                     | 4 | 3 | 5 | 3 | 3 | 3 | 4 | 4 | 5 | 18 |
|                        | TOF                     | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 2 | 4  |
| Subtotal thyroidectomy | IAP                     | 4 | 4 | 5 | 4 | 7 | 3 | 4 | 4 | 8 | 12 |
|                        | TOF                     | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 3 | 4  |

Number of contractions observed, reflect the blockage degree. In the absence of neuromuscular blocking agents, each pulse will produce a contraction and complete blockage inhibits any contraction [12]. To register TOF ratio, two electrodes, positive and negative can be placed on the path of several peripheral nerves. They should be placed on dry, fat-free hairless skin, at a distance of about 2-3 cm from each other [6]. Most often used in determining TOF ratio is used the ulnar nerve. The negative electrode is placed in the anterior forearm, 1-2 cm up to carpal region folds. The positive electrode is located at 2-3 cm proximal to the previous. It will be tracked the movements of thumb adduction [10]. If it is choosed the facial nerve monitoring, negative electrode is placed immediately above the earlobe, and the positive one, lateral to eyelid corners. It will be tracked the orbicularis muscle spasms [10]. For the lower limbs, is used, to monitor TOF ratio, posterior tibial nerve. The negative electrode is placed immediately below the medial malleolus and the positive to 2-3 cm higher. It will be tracked the short flexor muscle contractions of the big toe [8]. The ulnar nerve is indicated to be used whenever possible. Alternative variants come into consideration when there it's swelling in the upper limb, previous injuries of the ulnar nerve or fractures of the forearm [8]. In this study, all patients could be monitored using the ulnar nerve approach. The relationship between the degree of myorelaxation and intra-abdominal pressure is obvious. If the TOF ratio <2, intra-abdominal pressure was maintained at the same individual parameters, but the increasing more than 2 of TOF ratio caused a sudden increase in intra-abdominal pressure. This is explained by the degree of compliance of the abdominal wall. It is known that intra-abdominal pressure is maintained to normal or even slightly increased, even there are abdominal or parietal factors witch act positively. This is due to the degree of elasticity of the abdominal muscle wall which are able to take on some of the positive charges until reaching a critical point (usually IAP >15 mmHg) after, the intra-abdominal pressure increases suddenly [1]. Thus the degree of myorelaxation corresponding TOF ratio<2 was not enough to significantly alter the intra-abdominal pressure, exceeding this threshold instead led to sudden increases in intra-abdominal pressure in all analyzed.

## Conclusion

TOF ratio is an accurate indicator of the degree of neuromuscular blockage. The ulnar nerve was used in all cases, technically the most affordable and can be evaluated easily by following the thumb

adduction. TOF ratio values of 0 or 1 changed statistically insignificant the intra-abdominal pressure. Increase TOF ratio over 2 led to sudden increases in intra-abdominal pressure, especially when waking signs are starting.

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## Conflict of interests

Authors have no conflict of interests to disclose.

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