

# The Degree of Muscle Relaxation Requested by the Surgens during Upper Abdominal Surgery

Yoshikiyo AMAKI, Hiromi HAZIRI, Naoki SUGIMOTO,  
Yoshiyuki SHUDO and Kenichi KOBAYASHI

The degree of muscle relaxation required for the abdominal surgery should differ at different phase of operation. To test this hypothesis muscle relaxation was assessed subjectively by the surgeon and the results were compared with quantitative observations of the degree of response depression to train of four (t4) stimulation at various stages of surgery. Maximum relaxation, with a t4 ratio of less than 10%, was required immediately after the skin incision and during closure of the abdominal wall, while the requirement was minimal during the major part of surgery when the intra-abdominal procedures were performed. (Key words: train of four ratio, neuromuscular block, surgery, operative instrument)

(Amaki Y, Haziri H, Sugimoto N et al.: The degree of muscle relaxation requested by the surgens during upper abdominal surgery. *J Anesth* 4: 249-252, 1990)

The degree of muscle relaxation required during abdominal surgery varies at different stages of surgical procedures. In the present study of upper abdominal surgery, the degree of muscle relaxation assessed subjectively by the surgeon was compared with that of muscle relaxation assessed quantitatively utilizing train of four ratio (t4).

## Methods

This study was conducted on 125 male patients without neuromuscular disease, undergoing partial gastrectomy requiring less than 4 hr surgery and with the use of retractors during the operation. Patients ranged in age from 18 to 60 years, and all were within a normal obesity index. As premedication, 0.5 mg atropine sulphate and 10

mg diazepam was administered 1 hr before entrance to the operating room. Anesthesia was induced with 1 mg·kg<sup>-1</sup> succinylcholine and 5 mg·kg<sup>-1</sup> thiobarbiturate. After tracheal intubation, mechanical ventilation was performed with a ventilator. Optimal ventilation level was maintained by monitoring arterial blood gases (PCO<sub>2</sub> 35-40 mmHg, pH 7.35-7.45). During the operation, anesthesia was maintained with 50% nitrous oxide, 50% oxygen and 1-2% halothane. The neuromuscular block was induced with pancuronium and the degree of blockade was assessed with t4 response.

A nerve stimulator (MyoTest by Biometer) was used to apply supramaximal stimulation to the ulnar nerve at 0.3 msec width, 2 HZ and 10 second intervals. The mechanical twitch response to this stimulation of the adductor pollicis muscle was recorded (PALM CORDER, Nihon Denki Sanei) to obtain t4 ratio. Measurement was started after the disappearance of the effect of the succinylcholine, which was injected for intu-

---

*Department of Anesthesiology, Jikei University School of Medicine, Tokyo, Japan*

*Address reprint requests to Dr. Amaki: Department of Anesthesiology, Jikei University School of Medicine, Nishishinbashi 3-25-8, Minatoku, Tokyo, 105 Japan*

Please answer these questions at each of the following 3 stages by selecting the answer which is the closest to the actual state of the patient on that occasion: (1) beginning of peritoneal incision. (2) ten minutes after the insertion of retractors for laparotomy. (3) beginning of peritoneal suture at closing of the laparotomy wound.

1. Abdominal wall is completely relaxed giving rise to no difficulties
2. Relaxation of the abdominal wall is incomplete, but operation is feasible.
3. Relaxation of abdominal wall is so incomplete that operation is quite impossible.

Fig. 1. Questionnaire given to the operating surgeons

bation. Muscle relaxation was evaluated by 5 surgeons, each with more than 10 years of experience. Prior to the operation a questionnaire (fig. 1) was completed, and consent was also obtained for oral questioning during the operation. Continuous recording of the t4 ratio was conducted from the beginning to the end of anesthesia. Laparotomy was divided into three phases: phase 1, from skin incision to the end of peritoneal incision; phase 2, from the insertion of the retractor to extraction of the retractor at the end of the intraperitoneal manipulation; and phase 3, from peritoneal suture to the end of skin suture. In each phase, muscle relaxation was evaluated by the surgeons. Questions (fig. 1) were asked orally at three times during operation. All the answers to the questions were collected after operation and classed into three grade (answer 1: poor, answer 2: good, answer 3: excellent). The degree of neuromuscular blockade was classed into 3 grades: degree 1, t4 ratio more than 40%; degree 2, t4 ratio of 10-40%; and degree 3, t4 ratio less than 10%. These three grades resulted from the stepwise administration of pancuronium. The degree of blockade was measured at each stage in 30 patients.

### Results

Interview results at each stage (fig. 2) showed that the proportion of reply of dissatisfaction with the degree of muscle relaxation was high in phase 1 with degree 1 and

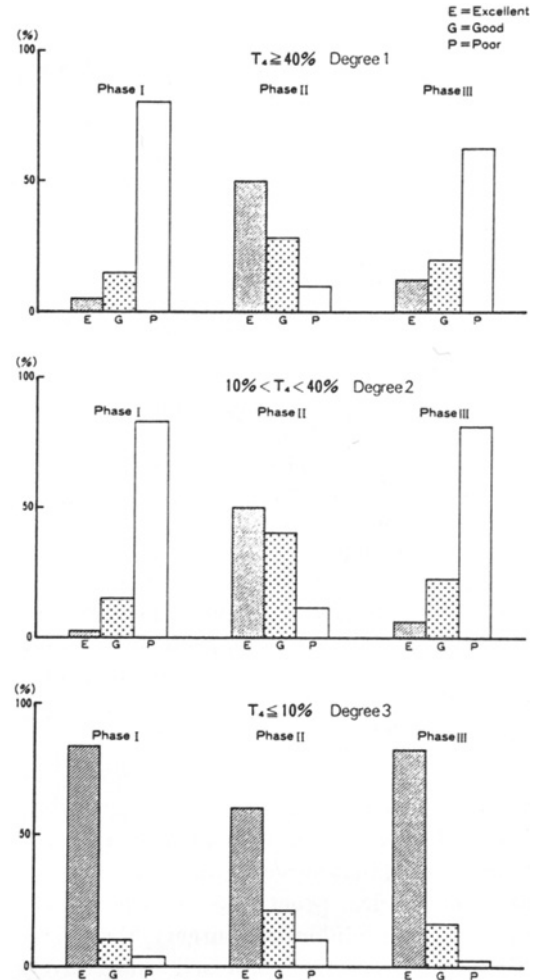


Fig. 2. The evaluation of muscle relaxation (%), calculated from the replies (154 cases), in different degree of block during the three stages.

2 blocks, necessitating the use of degree 3 block. In contrast, almost 60% of the replies were satisfaction with degree 1 and 2 blocks in phase 2. In phase 3, the proportion of reply of dissatisfaction again increased with degree 1 and 2 blocks, again necessitating the use of degree 3 blocks. Table 1 summarizes the replies, indicating satisfactory or almost satisfactory results. In degree 3 blocks, more than 90% of replies were satisfaction with the degree of muscle relaxation all the way from phase 1 to 3, while in degree 1 and 2 blocks, surgeons were replies were satisfaction only during phase 2.

**Table 1.** The "excellent" and "good" replies (%) in the different degree of block during the three phases

	The first phase (N=50)	The second phase (N=50)	The third phase (N=50)
T4 $\geq$ 40 Degree 1	20	90*	38
40 > T4 > 10 Degree 2	10	90*	26
T4 $\leq$ 10 Degree 3	93	91	99

\*Chi-square analysis compared "excellent" or "good" answers between the second phase and the first phase, the third phase. Results significantly different.

### Discussion

To quantitatively evaluate muscle relaxation, mechanical twitch response of the adductor pollicis muscle in response to ulnar nerve stimulation, was monitored. Many reports, including several on the optimal dose of muscle relaxant during operation, have utilized this method<sup>1,2</sup>.

This report based on collection of subjective information from surgeons, so selection of the patient with respect to age, sex, constitution and the use of intraperitoneal retractors during the operation, as well as of the surgeons themselves, strictly carried out.

Present study indicated that the most pronounced muscle relaxation is required on the time of peritoneal incision and peritoneal suturing, while the degree of required relaxation was unexpectedly the least during phase 2. The surgeons evaluation of the rigidity of the muscle includes not only degree of relaxation of the abdominal muscles, but also extrusion of the intestine from the wound caused by gas and food in the intestinal lumen, and by intestinal movement.

In phase 1 immediately after the induction of anesthesia the possibility of gastric dilatation due to accidental entrance of gas into the stomach through the mask should also be considered.

Depth of anesthesia and intestinal movement is also related<sup>3</sup>: Marshall et al.<sup>4</sup> reported on a decrease of movement of the stomach, ileum and jejunum in response

to halothane administration. Schurizek et al.<sup>5</sup> reported that general anesthesia with halothane reduced gastrointestinal motility, in relation to the inhaled concentration of halothane. Immediately after induction of anesthesia, the depth of anesthesia is still insufficient, and movement of the intestine is still active. These factors may contribute to the dissatisfaction of the surgeons, with degree 1 and 2 block during phase 1.

The different observations between phase 1, phase 3 and phase 2 probably depends on the insertion and removal of retractors. Retractors prevent the tension of the abdominal wall muscle being transmitted to the operative field, probably the main reason for the lower need for muscle relaxation in phase 2.

The intention of this report is by no means to emphasize maintenance of anesthesia with mild block: maintenance with too shallow block has been reported to cause muscle interruption<sup>6,7</sup>. It is our intention to emphasize that in addition to the quantitative information obtained by monitoring neuromuscular transmission, subjective information from the surgeons themselves should also be taken into consideration, and the level of muscle relaxation should be maintained reasonably.

(Received May. 31, 1989, accepted for publication Mar. 15, 1990)

### References

1. Shanks CA: Pharmacokinetics of the nondepolarizing neuromuscular relaxants applied

- to calculation of bolus and infusion dosage regimens. *Anesthesiology* 64:72-86, 1986
2. Hollander AD, Massaux F, Nevelsteen M, Agoston S: Age-dependent dose-response relationship of org NC45 in anaesthetized patients. *Br J Anaesth* 54:653-657, 1982
  3. Aitkenhead AR: Anaesthesia and bowel surgery. *Br J Anaesth* 56:95-101, 1984
  4. Marshall FN, Pittinger CB, Long JP: Effects of halothane on gastrointestinal motility. *Anesthesiology* 22:363-366, 1961
  5. Schurizek BA, Willacy LHO, Kraglund K, Andreasen F and Juhl B: Effects of general anaesthesia with halothane on antroduodenal motility, pH and gastric emptying rate in man. *Br J Anaesth* 62:129-137, 1989
  6. Poole GV: Mechanical factors in abdominal wound closure: The prevention of fascial dehiscence. *Surgery* 97:631-639, 1985
  7. Carison DC, Wornom III IL, Aldrete JS: Abdominal wound closure. *The Alabama Journal of Medical Sciences* 21:49-53, 1984