**Neuromuscular Blockade for Abdominal Surgery**

Neuromuscular blockade (NMB) is commonly used during surgery for three purposes: to facilitate intubation, to decrease patient movement, and to improve operating conditions for the surgeon. Succinylcholine or a non-depolarizing neuromuscular blocker is used for intubation, and non-depolarizing blockers are also used for maintenance of paralysis. Of the non-depolarizing blockers, we most commonly use Rocuronium at Stanford; however, our carts are also stocked with Vecuronium and Pancuronium. Cisatracurium is the neuromuscular blocker of choice in patients with hepatic or renal disease because of its organ-independent elimination by Hoffman degradation, and it is kept in the refrigerator at the OR pharmacy and in cardiac rooms.

Optimal intubating conditions include complete relaxation of the vocal cords. This can be achieved with deep anesthesia in the absence of NMB; however, a higher dose of anesthetic would be required, which can in turn have adverse effects. Thus, NMBs are used in adults virtually every time the trachea is intubated. Typical intubating doses are as follows:

Rocuronium: 0.6 mg/kg, up to 1.2 mg/kg for RSI

Vecuronium: 0.1 mg/kg

Cisatracurium: 0.2 mg/kg, up to 0.6 mg/kg for RSI

NMB is monitored by stimulating peripheral nerves and observing muscle twitches. Different muscle groups have different susceptibilities, onset, and offset times. The muscles of the larynx and diaphragm become paralyzed quickly and are quick to recover, whereas the muscles of the pharynx have slower onset and offset. Twitch monitoring at the corrugator supercilii (medial eyebrow) reflects the time course of paralysis of the larynx and diaphragm, whereas twitch monitoring at the abductor pollicis better reflects that of the pharyngeal muscles. Therefore, it follows that the corrugator twitch is a better indicator of intubating conditions than the abductor pollicis twitch, and vice versa for extubating conditions (as both the muscles of respiration and the muscles that protect the airway must recover in order to extubate the trachea successfully).

In addition to facilitating intubation and decreasing the chance of patient movement during surgery, neuromuscular blockade is often requested for relaxation of the abdominal musculature. Whether or not NMB actually improves operating conditions in abdominal surgery is a subject of controversy. There is a paucity of literature on this subject. A French study of 50 patients undergoing gynecologic laparoscopy showed that the use or non-use of atracurium titrated to twitch height < 10% of the control value did not affect operating conditions as assessed on a 4-point scale at 10-min intervals throughout the cases. However, many surgeons believe that relaxation of the abdominal wall musculature is beneficial, and they may specifically ask for paralysis during the case. In this case, it may be best to fulfill the surgeon’s request without argument, as a discussion of the risks vs. benefits of maintaining muscle relaxation is probably not beneficial to the relationship between the surgical and anesthesia teams. Conventional practice suggests a keeping the train of four at 1/4 twitches throughout an abdominal case. This allows for reversal should the case end sooner than expected.

One word of caution: Dr. Gregg is extremely fast with both open and laparoscopic cases, and many residents have had the unfortunate experience of giving a dose of Rocuronium only to hear him say “We’re finished” several minutes later. We suggest avoiding additional doses of neuromuscular blockers after the intubating dose unless he specifically asks for them.

Dr. Morton will constantly ask for paralysis despite zero twitches!! Please contact your attending if you are uncertain about what to do.

**Board Review Questions**

1. Which of the following muscle groups demonstrates the earliest recovery from neuromuscular blockade following administration of an anticholinesterase agent?
   1. Adductor pollicis
   2. Diaphragm
   3. Geniohyoid
   4. Pharyngeal
   5. Flexor hallucis

Answer: B. The diaphragm exhibits the most rapid recovery from neuromuscular blockade. Recovery o f upper airway and pharyngeal muscles (e.g., geniohyoid) and flexor hallucis muscle generally parallels that of the adductor pollicis.

Source: Connelly and Silverman, *Review of Clinical Anesthesia*, 4th ed., 2006.

1. A 58 year-old woman with a diagnosis of myasthenia gravis underwent a laparotomy. Her anesthesia consisted of thiopental, nitrous oxide, fentanyl, and oxygen, with pancuronium as a muscle relaxant in a total dose of 1 mg. During the procedure, the patient received an intravenous dose of gentamicin. The patient remained apneic at the end of the procedure. The cause of the apnea could be ascribed to all of the following EXCEPT:
   1. Thiopental
   2. Myasthenia gravis
   3. Pancuronium
   4. Fentanyl
   5. Gentamicin

Answer: A. In the case cited, any of the options except thiopental may be involved in the apnea. Thiopental, in usual doses, should not cause apnea after a procedure as long as a laparotomy. Any of the other options or a combination of the options can be the cause. Aminoglycosides are associated with decreased muscle function or potentiation of muscle relaxants in a dose-related fashion. This is probably due to a prejunctional inhibition of acetylcholine release.

Source: Appleton & Lange, *The MGH Board Review of Anesthesiology*, 5th ed., 1999.

**References**

Chassard D et al. [Gynecologic laparoscopy with or without curare]. Article in French. Ann Fr Anesth Reanim. 1996;15(7):1013-7.

Hemmerling TM and Donati F. Neuromuscular blockade at the larynx, the diaphragm, and the corrugator supercilii muscle: a review. Can J Anesth 2003;50(8);779-94.