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Recollections of Intentional Awake Neuromuscular Paralysis

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Introduction

The first author has been working on a new technique for endotracheal intubation for a number of months. The technique has been shown to be simple and effective on awake subjects with well anesthetized airways. Whether the technique would work in paralyzed patients ventilated with positive pressure ventilation under general anesthesia had not been determined. Since attempting an untried technique on a patient would be of dubious ethical propriety, the first author decided to be the first experimental subject. As he is exceedingly possessive of this development and wanted to be able to make suggestions during the trial, he arranged to be awake but paralyzed, using a technique of isolating the circulation in his dominant arm.

Method

A colleague was instructed in the use of the technique and invention. A second colleague was recruited to manage the “anaesthetic” and provide suggestions, be an extra pair of hands and generally help out. A research assistant managed two video “cam-corders”. The subject was fasted overnight except for 30 ml of sodium citrate 0.3 Molar. Glycopyrolate 0.4mg was given IM 90 minutes prior to “induction”. The airway was anesthetized with topical application of 2% lidocaine via De Vilbis atomizer, bilateral superior laryngeal nerve blocks (2ml 2% lidocaine per side) and transtracheal injection of 4ml 2% lidocaine. The anaesthetic machine and drug cart were prepared as if for a normal general anesthetic. The monitors were applied, including EKG, pulse oximeter, blood pressure cuff and an 18 gauge intravenous was started in the subjects nondominant hand. A capnograph was attached to the circuit. An occlusive tourniquet was placed on

the upper arm of the dominant side and set for 200mmHg (approximately 150% of the subjects' systolic BP) and tested. Hand signals for "yes", "no", "I can't stand it, put me to sleep", "more ventilation please" were pre-arranged. It was also agreed that the subject would continue to move the fingers of his non-occluded arm as long as he could to give some indication of the onset of neuromuscular blockade. A pad of paper was placed under the dominant hand, which held a pen. These preparations complete, a rehearsal of each participant's duties was performed. The subject was then preoxygenated with 100% oxygen, the tourniquet was inflated to 200 mmHg and a dose of 8mg (0.08mg/kg) of vecuronium was given intravenously.

Results

Within three minutes of the injection of vecuronium no further movement was detectable in the subject's non-occluded arm. The subject was ventilated easily with face mask and circle circuit. The first attempt at intubation was made unsuccessfully at 4 minutes. A modification of the technique was made and further attempts were made again without success. At this point the subject's BP had risen from 140/ 100 to 172/108 and a heart rate of 110 was noted. Esmolol 80 mg was given in increments. The subject indicated by hand signals and short written notes that he wished to continue. Further modifications of techniques were performed as pre-arranged, again without success. During these times the EtCO2 remained 20 - 30 mm Hg. Fourteen minutes after injection of the vecuronium the subject indicated by a barely legible note that he wished to "give up", and just be ventilated by bag and mask until the neuromuscular block was reversible. Shortly thereafter, 1.8 mg atropine and 5 mg neostigmine were given. Within 2 minutes spontaneous movements were noted in the hands and legs and short "jerky" attempts at inspiration were observed. At this point the subject requested a further 2.5 mg of neostigmine by phonating on a "bagged" breath.

What I Felt

Initially, as I became progressively weaker I was impressed with the slowness of onset of the neuro-muscular block and began to comment on it. Halfway through the sentence my ability to articulate words vanished as my tongue lost all power. The "anesthetist" then tightened his grip on my jaw, trapping my lower lip between my incisors while he arranged to administer 100% oxygen by face mask ventilation. Not only did this cause some pain, it caused sufficient obstruction to the flow of oxygen that I first experienced "air hunger". I scribbled a note "lip" and the "anesthetist" repositioned his hand and mask to free my lip. Sadly, my tongue was now caught between my molars. Oxygen entry improved, quickly allaying my air hunger. During the first attempt at intubation with the device I had no discomfort, only frustration that the technique was not working as anticipated. The technique did interfere with regular ventilation so I gave the "bag me more" sign and my colleague complied. During the second phase of the attempt, an oropharyngeal airway was placed and gave me enormous relief, both of air hunger and by

preventing my teeth from occluding on my tongue, lips or cheeks. I became aware of my tachycardia and scribbled “BP?”. It was comforting to know my pressure was back down to the pre “induction” levels. At one point, after what seemed like a prolonged period of apnea (approximately 20 seconds), while preparing for the next attempt, my air hunger was so great I desperately signalled for ventilation. My colleagues complied with such vigor that I was soon having paraesthesia of the feet and nonoccluded hand. Throughout, my colleagues were very attentive to my needs, and called out blood pressure and SaO2 from time to time to reassure me. This, however, did not allay my fear that if the oropharyngeal airway was dislodged or malpositioned I might experience air hunger even worse than previously. Despite topical anesthesia, sensations from my airway were sufficient that I could tell when the airway device was close to the larynx and could sense that one attempt had been a very near miss. This added to my frustration and disappointment. After about 14 minutes of paralysis and several intubation attempts I realized that my invention could not be used to easily or reliably intubate paralyzed patients and decided to abandon the trial. I scribbled a note: “give up”, with which my colleagues were only too happy to comply. Writing had become increasingly difficult as fine motor control and proprioception were failing at this time, presumably due to ischemia. Gross motor control was still good. At this point, subjectively, I was totally paralyzed, unable even to rub the fingers of my nonoccluded hand together. After the onset of the neostigmine, strength returned perceptibly but insufficiently. As I have demonstrated to many medical students and anesthesia residents, there was strength to initiate an action but not to carry it through. My colleague did an excellent job of supplementing my spontaneous attempts at respiration and I was able to phonate with the air he had “bagged” into me: “more Neo please!”. Eventually, I was able to breathe well spontaneously and soon could sustain a head lift for 10 seconds. Being the heaviest person in the room, I restrained my desire to sit up immediately. When I did sit up, I found I was quite dizzy and vertiginous despite total lack of sedating drugs in my “anaesthetic”. The dizziness passed if I closed my eyes and when I opened them vision was blurred and diplopic. This sensation lasted about one hour “post-op”.

Conclusion

Despite the physical unpleasantness involved, the experiment was a success in answering the primary question: Would the new invention/ technique facilitate intubation in the unconscious, paralyzed patient? Sadly, the answer was, no. An additional outcome was an increased awareness of just how unpleasant conscious neuromuscular blockade can be, particularly the acute air hunger that accompanies even short interruptions of positive pressure ventilation. Also highlighted was the extreme attention to detail necessary to avoid “collateral damage” to lips, tongue and buccal mucosa when giving a mask anaesthetic. A final outcome was recognition that ischemia limits the usefulness of the isolated arm technique to about 15 minutes if fine motor control is necessary for communication.