ROBOT-ASSISTED NERVE BLOCKS – INFLUENCE ON USER PERFORMANCE AND LEARNING CURVES

Presenting Author: Thomas M Hemmerling, MSc, MD, DEAA, ITAG Laboratory, MUHC & Arnold and Blema Steinberg Medical Simulation Centre, McGill University

Co-Authors: Nora Terrasini, MD, Joshua Morse, Mohamad Wehbe, MSc, Christophe Philippona, Cedrick Zaouter,MD, ITAG Laboratory, MUHC, McGill University, Montreal, Canada.

Introduction: Robot-assisted surgery helps to achieve shorter learning curves and better accuracy than manual surgery.[1-3] We compared success rates, performance and learning curves of ultrasound (US) -guided robot- assisted versus manually performed nerve blocks using a nerve block phantom.

Methods: The 5 co-authors had different expertise in using the robotic system (Magellan robotic nerve block system[4]) and in performing nerve blocks. One co-author (CZ) had less than 1 years of experience in performing nerve blocks; the other co-authors were one anesthesia resident (NT) and graduate (MW) or undergraduate engineering students (JM, CP) with no experience in nerve blocks. Only two co-authors (JM, MW) had prior experience with the Magellan system. Each co-author was asked to perform 4 different procedures using a nerve block phantom (Blue Phantom, WA, USA), with 10 repeated trials for each procedure. The procedures were: 1) to perform manually an US-guided nerve block of the superficial nerve (MSN); 2) to perform manually an US-guided nerve block of the profound nerve (MPN); 3) to perform an US-guided nerve block of the superficial nerve using the Magellan system (RSN); 4) to perform an US-guided nerve block of the profound nerve using the Magellan system (RPN). (Fig. 1) The block was considered successful when the needle reached the target nerve. All co-authors had the same starting position for each trial. The time from the starting position until the target was successfully reached was measured (Performance time). Average performance times were compared using ANOVA (SPSS). Learning curves were calculated using linear regression. $P<0.05$ was considered significant. Data presented as means ± SD.

Results: All blocks were successful. Time to perform MSN, RSN, MPN, and RPN were 4.38 s ± 3.1s, 26.78 s ± 13.02 s, 9.6 s ± 12.26 s and 24.92 ± 15.24 s, respectively. There were significant differences in performance times between the co- authors to perform MSN ($P = 0.001$) and MPN ($P = 0.0001$), respectively. Mean times (of 10 trials per each co-authors) for MSN were 3.11 s ± 0.84, 3.51 s ± 1.32, 7.0 s ± 6.04, 4.82 s ± 0.76, 3.35 s ± 0.91 for CZ, CP, JM, MW, NT, respectively. Mean times (of 10 trials per each co-authors) for MPN were 9.05 s ± 6.77, 3.74 s ± 0.86, 19.4 s ± 23.61, 12.11 s ± 4.59, 3.74 s ± 1.59 for CZ, CP, JM, MW, NT, respectively. The performing times were not significantly different between the co-authors for robot-assisted nerve blocks. The average learning curve (all co-authors) to perform robot-assisted nerve blocks was significantly ($P=0.007$) steeper than the learning curve to perform the blocks manually at 1.8 s ± 1.6 s versus 0.3 s ± 0.3 s, respectively per trial. (Fig 2, 3)

Conclusion: The use of a robot to perform nerve blocks decreases inter-subject performance variability; users have steeper learning curves when using the robot than without.

References: 1. Am J Surg 2004; 187: 309-15. **2.** Surg Laparosc Endosc Percutan Tech 2007; 17: 171-4. **3.** Int J Med Robot 2010; **4** Anesth Analg 2012; 115:S44.

Fig.1: The nerve block model used in this study. In the ultrasound image, the 2 target nerves are shown.

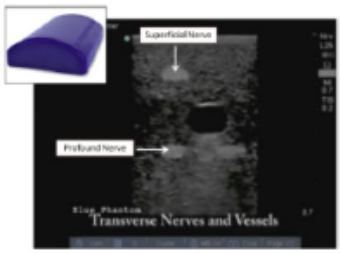

Fig.2: Mean times for each trial plotted as points (errors bars represent SD). A and B show the trend of learning curve for MSN and RSN blocks, respectively.

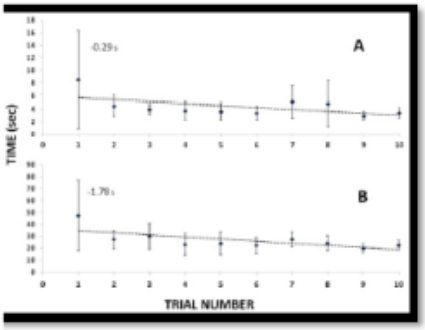

Fig.3: Mean times for each trial plotted as points (errors bars represent SD). C and D show the trend of learning curve for MPN and RPN blocks, respectively.