Ergonomic considerations in natural orifice transluminal endoscopic surgery

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Abstract. From a technological perspective, there is a natural progression in surgical technique, evolving from traditional open surgery to minimally invasive surgery (MIS), to non-invasive surgery (i.e., natural orifice transluminal endoscopic surgery (NOTES)). The last is the most recent, and most challenging, for the surgeon. In NOTES, surgical sites are accessed through a single incision made either transgastrically or transrectally, or transvaginally (for the female patient population). Visualisation is limited and manipulation of target tissue is constrained. A hierarchical task analysis of NOTES appendectomy and NOTES cholecystectomy procedures was conducted, along with a cognitive task analysis performed with expert NOTES surgeons. Analyses revealed increased complexities of the NOTES technique compared with the laparoscopic technique, resulting in significantly longer procedure times (at least twice as long depending on the procedure). Results also showed that the human factors and ergonomics issues normally encountered in MIS (such as spatial disorientation and limited degrees of freedom in tool manipulation) are more pronounced in NOTES. Additional ergonomic issues as a result of the increased complexity of the surgical technique are also noted. For example, handling of target tissue is limited to one aspect of the surgical site, as defined by the flexible endoscope’s approach. A second tool is sometimes needed to lift or anchor the target tissue from the opposing aspect, requiring an additional port to be introduced – thereby negating the cosmetic advantage of “no scars” from the NOTES procedure. These additional difficulties are partly due to the fact that the surgical tools and instrumentation used for NOTES are borrowed from the MIS tool box, which have not been developed to meet the increased task demands. This presentation will present the results of this study, with specific design recommendations for NOTES instrumentation.