Effect of video latency on performance and subjective experience in laparoscopic surgery

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Rationale

Minimally invasive surgery enables surgery with minimal trauma to the patient using specialized instruments and video acquired from an optical camera (endoscope) which is visualized on a display. Latency in the imaging chain can cause dissociation between perception and action, which can degrade the surgeon's performance. Existing latency studies focus mostly on robotic surgery, and results are inconsistent: some indicate latencies of 500 milliseconds (ms) are feasible, while others note performance degradation at 250 ms, and very few test latencies below 250 ms. In addition, task duration and errors are measured, but not the surgeon's subjective experience. This study aims to fill the gap by studying the effects of latencies below 200 ms on task performance and subjective experience in laparoscopic surgery.

Methods

Thirty surgeons conducted a suture manipulation task on a laparoscopy training box with one trial each for six latency conditions: 0, 15, 45, 75, 105, and 135 ms, with inherent system latency of 55 ms. Task duration was measured, and surgeons answered five questions on perceived efficiency, perceived latency, level of annoyance, adaptation, and perceived impact on patient safety, using a 6-point Likert scale. Surgeons were grouped into novices (less than 5 years of laparoscopy experience) and experts (more than 5 years).

Results

Task duration was lower for experienced surgeons than for novices and increased for both groups as latency increased. At 105 ms latency and above, the level of annoyance was increased, while perceived efficiency and ability to adapt were reduced for experts; novices were disturbed even at lower latencies. Higher latencies were perceived as more detrimental to patient safety.

Conclusions

The results indicate laparoscopy operator performance and perceived effectiveness are degraded above 75 ms added latency (130 ms total latency), with negative impact on perceived patient safety.

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