Patient Safety and Human Factors Research for Surgical Automation

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Introduction

The automation of surgical procedures is increasing in modern operating rooms (ORs). This not only includes mechatronic devices and robotics but also automated decision and image processing systems.

Automation is defined in engineering psychology as a device or system that accomplishes (partially or in full) a function that was previously, or conceivably could be, carried out (partially or in full) by a human operator. This includes any sensing, detection, information-processing, decision-making or control action in the OR.

In order to increase the patient safety as well as the safety of the team and the operator, it is important to study the consequences of this automation process in detail. Therefore, it is important to develop usability labs based on surgical simulators. This allows studying automation in experiments that would be too dangerous to study in patient trials.

Methods

Different experimental studies were executed in the simulator OR to study several automation criteria, such as mode awareness, loss of skills or cognitive workload. The study subjects in these studies were expert and novice surgeons. The simulator OR included standard surgical equipment (medical devices as well as instruments) and mechatronic patient simulators.

Results

The studies show that experts have better results when using standard equipment. This shows that the simulation environment is valid.

The studies show further that these differences are decreasing if automation – in particular new and innovative equipment – is used.

Conclusion

Surgical automation can have many advantages compared to manual work, if the equipment is carefully designed. Simulator environments are useful for evaluation experiments to prove these advantages in pre-clinical studies.