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The Digital Microscopy in Organ Transplantation: Ergonomics of the Tele-Pathological Evaluation of Renal, Liver, and Pancreatic Grafts

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Abstract : The process to build a better safety culture, methods of error analysis, and preventive measures, starts with an understanding of the effects when human factors engineering refer to remote microscopic diagnosis in surgery and specially in organ transplantation for the evaluation of the grafts. A high percentage of solid organs arrive at the recipient hospitals and are considered as injured or improper for transplantation in the UK. Digital microscopy adds information on a microscopic level about the grafts (G) in Organ Transplant (OT), and may lead to a change in their management. Such a method will reduce the possibility that a diseased G will arrive at the recipient hospital for implantation. Aim: The aim of this study is to analyze the ergonomics of digital microscopy (DM) based on virtual slides, on telemedicine systems (TS) for tele-pathological evaluation (TPE) of the grafts (G) in organ transplantation (OT). Material and Methods: By experimental simulation, the ergonomics of DM for microscopic TPE of renal graft (RG), liver graft (LG) and pancreatic graft (PG) tissues is analyzed. In fact, this corresponded to the ergonomics of digital microscopy for TPE in OT by applying virtual slide (VS) system for graft tissue image capture, for remote diagnoses of possible microscopic inflammatory and/or neoplastic lesions. Experimentation included the development of an OTE-TS similar experimental telemedicine system (Exp.-TS) for simulating the integrated VS based microscopic TPE of RG, LG and PG Simulation of DM on TS based TPE performed by 2 specialists on a total of 238 human renal graft (RG), 172 liver graft (LG) and 108 pancreatic graft (PG) tissues digital microscopic images for inflammatory and neoplastic lesions on four electronic spaces of the four used TS. Results: Statistical analysis of specialist's answers about the ability to accurately diagnose the diseased RG, LG and PG tissues on the electronic space among four TS (A,B,C,D) showed that DM on TS for TPE in OT is elaborated perfectly on the ES of a desktop, followed by the ES of the applied Exp.-TS. Tablet and mobile-phone ES seem significantly risky for the application of DM in OT ($p<.001$). Conclusion: To make the largest reduction in errors and adverse events referring to the quality of the grafts, it will take application of human factors engineering to procurement, design, audit, and awareness-raising activities. Consequently, it will take an investment in new training, people, and other changes to management activities for DM in OT. The simulating VS based TPE with DM of RG, LG and PG tissues after retrieval, seem feasible and reliable and dependable on the size of the electronic space of the applied TS, for remote prevention of diseased grafts from being retrieved and/or sent to the recipient hospital and for post-grafting and pre-transplant planning.

Keywords : digital microscopy, organ transplantation, tele-pathology, virtual slides
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