Holography Supported Minimally Invasive Cardiac Surgery: A Proof of Concept and First-in-Man

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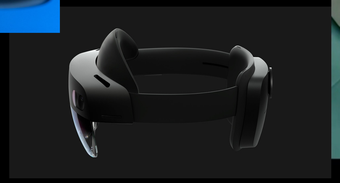
Background

- Successful MICS, especially totally endoscopic approach, requires accurate placement of incisions and ports for adequate exposure and minimum surgical trauma
- Holographic guidance with HoloLens 2 using pre-op 3D CT reconstruction was used to enhance surgical decision making

HoloLens 2

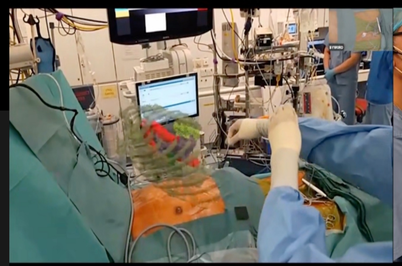
- Mixed reality device from Microsoft
- Features: hand tracking, built-in voice commands, eye tracking, spatial mapping, and large field of view
- Allows for precise, efficient preoperative planning





Methods

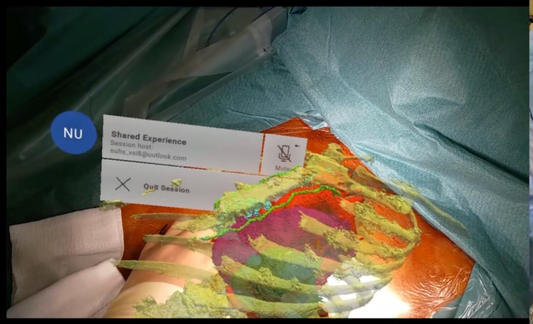
- 3 MICS cases: 1 AVR, 1 PVR, 1 multivessel CABG
- 3D CT and specialised slicer software were used to create holograms of heart, ribcage and great vessels
  - ❑ AVR: focus on position of valve and aorta
  - ❑ PVR: focus on valve annulus
  - ❑ CABG: focus on aorta, course of left IMA and coronary target
- Using HoloLens 2, holograms were superimposed on patient's exposed chest 1-to-1 using anatomical landmarks (clavicles, xiphoid)
- Decisions regarding optimal incision site and anticipated topography and trajectory of instruments can be made





Hologram Positioning







Results

- Optimal exposure was achieved in all cases
- Gated CTCA ideal for constructing holograms of mammary arteries and coronary targets
- HRCT sufficient for constructing holograms of intrathoracic topography, congenital anomalies and assessing anticipated degree of difficulty

Conclusions

- Proof-of-Concept
- Superimposed holograms with a specialised toolkit facilitates critical decisions in MICS
- Enhances efficiency and ergonomics of surgery

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