Virtual Reality Spatial Recognition Simulation in Laparoscopic Colorectal Resection: Initial Experience and Evaluation

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COI Disclosure

Noriko Ikeda

The author has no financial conflicts of interest to disclose concerning the presentation.

Background

- Advanced surgical navigation tools, including AI and VR technologies, have emerged as transformative solutions in modern surgical practice
- VR holography offers unique advantages:
  - Enhanced 3D visualization of complex anatomy
  - Improved precision in preoperative planning
  - Superior surgical outcomes through better spatial recognition
- This study evaluates the initial implementation of VR simulation in laparoscopic colorectal surgery, focusing on its impact on surgical precision and team performance

Methods

- Study Design
  Retrospective analysis of colorectal cancer cases utilizing VR holography in perioperative planning and execution
- Patient Demographics
  Number of patients: 5
  Mean age: 74.6 years
  Gender ratio (M:F): 2:3
- Tumor Location
  Ascending colon (n=1)
  Transverse colon (n=1)
  Sigmoid colon (n=1)
  Rectum (n=2)
- Surgical Procedures
  Right hemicolectomy (n=2)
  Sigmoid colectomy (n=1)
  Low anterior resection (n=2)

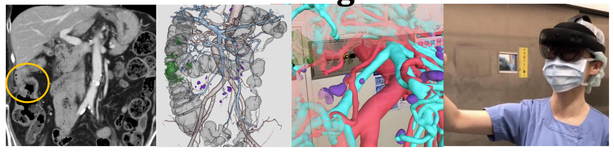
Hologram Creation

- Contrast-enhanced CT data processed using Ziostation (AMIN®) for 3D analysis
- Converted to polygon data via STC output and visualized using HoloLens
- Patient-specific 3D models enabled detailed preoperative planning and surgical rehearsal

Case Presentation:

80-Year-Old Female with Right Hemicolectomy (UICC pStage IIA)

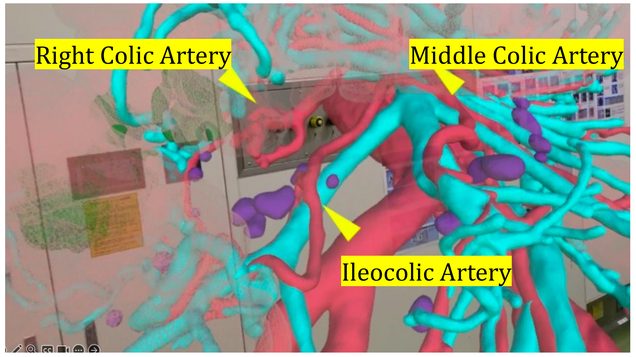
Transforming CT Images into Holograms



CE-CT | 3D image Zio (AMIN) | Polygon data | Head-Mount Display (Holoeyes)

STC output

Preoperative simulation



Last minute simulation

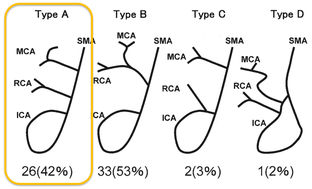


Yu Saito et al. Annals of Surgery, 2019

Staff communication



Vascular Variations in Right Hemicolectomy

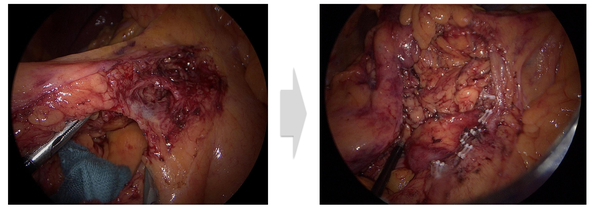


This case

Hashizume et al. 2012 The Journal of the Japan Surgical Association

The "Last Minute Simulation" during surgery reconfirmed that the vascular branching pattern in this case was Type A.

Vascular Management and Lymphadenectomy Guided by VR Navigation



Initiation of lymph node dissection along the surgical trunk

Completion of lymph node dissection

Results

Mean operative time 205 minutes

Average blood loss 38 ml

VR holography demonstrated:

- Facilitated identification of vascular anomalies
- Enhanced precise localization and dissection of lymph nodes
- Real-time intraoperative guidance in complex anatomical regions
- Improved team coordination with shared surgical visualization

No perioperative complications observed

Three Key Roles of VR

1. Preoperative Simulation
2. Intraoperative "Last Minute Simulation"
3. Staff Communication

Conclusion

- VR holography enabled accurate vascular and lymph node identification, improving surgical precision.
- Enhanced visualization and surgical planning contributed to improved laparoscopic colorectal resection.
- Further VR innovations could enhance its clinical utility, leading to better outcomes in minimally invasive surgery.