Value Of Cloud-based Artificial Intelligence (AI) Driven Video Analytics In General Surgery

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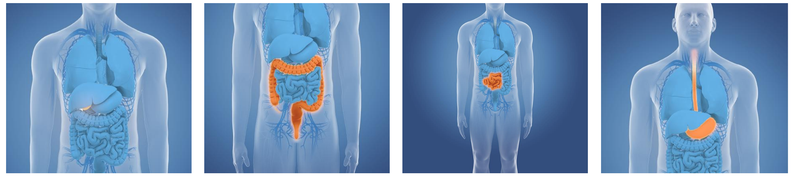
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Background

- New age computing tools such as cloud computing and Artificial Intelligence (AI) may lead to a revolution in the generation of insights based on surgical video analytics, particularly for laparoscopic and robotic surgery.
- Existing use-cases are nascent, and these technologies may fundamentally change training and quality paradigms.
- Our objective was to better understand clinical use cases and value of video-based performance insights in General Surgery.

Methods

- A narrative literature review was conducted utilizing PubMed, restricted to studies from the past 5 years.
- Additional perspective of an academic center's experience with a cloud-based AI driven video analytics platform over the past one year was also included.
- Data on use-cases were extracted.
- Focus was on commonly performed laparoscopic and robotic general surgical procedures.



Results

- Prominent use case was in automated recognition of the various phases of surgery in laparoscopic procedures including: (Gendia 2022)
  - Cholecystectomy, appendectomy
  - Sleeve gastrectomy, Roux-en-Y gastric bypass
  - Colectomy
  - Hernia repair
- Phase specific times were analyzed in multiple studies and were used to benchmark performance by attending surgeons, residents, and fellows.
- Studies document the gradation of surgical skills using (Grüter 2023):
  - Global Evaluative Assessment of Laparoscopic Skills (GOALS)
  - Global Evaluative Assessment of Robotic Skills (GEARS) scales
  - Procedure specific scales such as Colorectal Objective Structured Assessment of Technical Skill (COSATS) for right hemicolectomy
- Procedure-specific analytics in laparoscopic cholecystectomy:
  - Achievement of critical view of safety (CVS) (Owen 2022)
  - Gradation of operative complexity (Tranter-Entwistle 2022)
- Additional applications such as instrument recognition, economy of motion, critical structure identification and automated generation of operative notes were also documented, with less frequency (Anteby 2021).
- Surgeon awareness of phase specific times may represent a path to achieving efficiency, surgeon skills improvement and clinical outcomes improvement.
- Barriers related to hospital Information Technology (IT) stakeholders including patients, surgeons, hospitals and regulatory agencies and medico-legal concerns remain.



Phase analysis for Roux-en-Y gastric bypass

Conclusions

- New age video analytics present a powerful tool with potential to revolutionize surgical practice and care delivery.
- Further procedure specific, large scale validated use cases need to be highlighted in the medical literature and linked to outcomes.

References

- Owen D, Grammatikopoulou M, Luengo I, Stoyanov D. Automated identification of critical structures in laparoscopic cholecystectomy. Int J Comput Assist Radiol Surg. 2022 Dec;17(12):2173-2181. doi: 10.1007/s11548-022-02771-4. Epub 2022 Oct 22. PMID: 36272018.
- Tranter-Entwistle I, Eglinton T, Connor S, Hugh TJ. Operative difficulty in laparoscopic cholecystectomy: considering the role of machine learning platforms in clinical practice . Art Int Surg 2022;2:46-56. http://dx.doi.org/10.20517/ais.2022.01
- Hashimoto DA, Rosman G, Witkowski ER, Stafford C, Navarette-Welton AJ, Rattner DW, Lillemoe KD, Rus DL, Meireles OR. Computer Vision Analysis of Intraoperative Video: Automated Recognition of Operative Steps in Laparoscopic Sleeve Gastrectomy. Ann Surg. 2019 Sep;270(3):414-421. doi: 10.1097/SLA.0000000000003460. PMID: 31274652; PMCID: PMC7216040.
- Grüter AAJ, Van Lieshout AS, van Oostendorp SE, Henckens SPG, Ket JCF, Gisbertz SS, Toorenvliet BR, Tanis PJ, Bonjer HJ, Tuynman JB. Video-based tools for surgical quality assessment of technical skills in laparoscopic procedures: a systematic review. Surg Endosc. 2023 Jun;37(6):4279-4297. doi: 10.1007/s00464-023-10076-z. Epub 2023 Apr 26. PMID: 37099157; PMCID: PMC10234871.
- Gendia A. Cloud Based AI-Driven Video Analytics (CAVs) in Laparoscopic Surgery: A Step Closer to a Virtual Portfolio. Cureus. 2022 Sep 12;14(9):e29087. doi: 10.7759/cureus.29087. PMID: 36259009; PMCID: PMC9559410.
- Anteby R, Horesh N, Soffer S, Zager Y, Barash Y, Amiel I, Rosin D, Gutman M, Klang E. Deep learning visual analysis in laparoscopic surgery: a systematic review and diagnostic test accuracy meta-analysis. Surg Endosc. 2021 Apr;35(4):1521-1533. doi: 10.1007/s00464-020-08168-1. Epub 2021 Jan 4. PMID: 33398560.