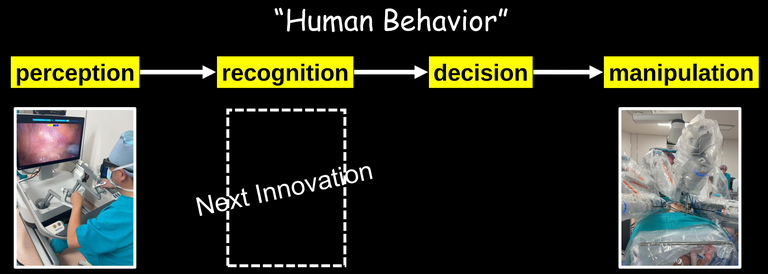
Intraoperative Organ Recognition Model Using AI in Minimal Invasive Colorectal Surgery

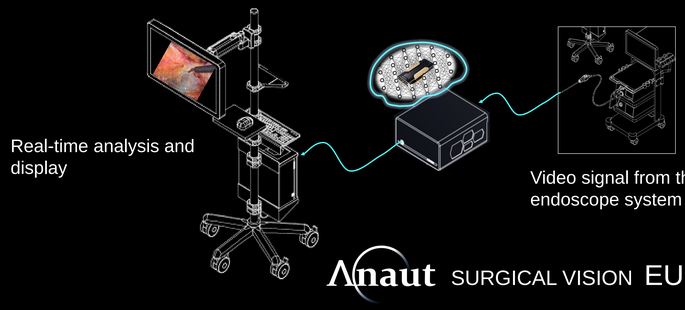
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Aim

In general, human behavior is considered to be composed of “perception,” “recognition,” “decision,” and “manipulation” elements. In surgery, surgeons first recognize the information that comes to their eyes, understands the anatomical location, determines where to proceed, and actually performs the manipulation. Although there has been a remarkable evolution of devices such as cameras and robots in recent years, this part of recognition is largely dependent on the surgeon's knowledge and experience.

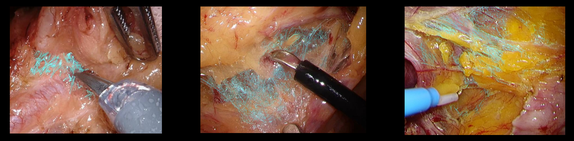


The tool that assists surgeons in recognition phase is SURGICAL VISION EUREKA by Anaut inc., an organ recognition-assisted AI. EUREKA analyzes video signals from the endoscopy system and displays the results in real time.



We believe AI can assist surgeon’s organ recognition and improve the safety and quality of surgery. The aim of this study is to examine the usefulness of the AI models.

Methods



Kumazu Y, et al. Sci Rep. 2021

Anaut inc. and we developed AI recognition model for loose connective tissue fibers (LCTFs), nerves, pancreas and ureter in laparoscopic or robotic colorectal surgery based on video clips of gastric cancer, colorectal cancer, and inguinal hernia surgery.
The performance of the AI model was assessed through quantitative and qualitative studies.

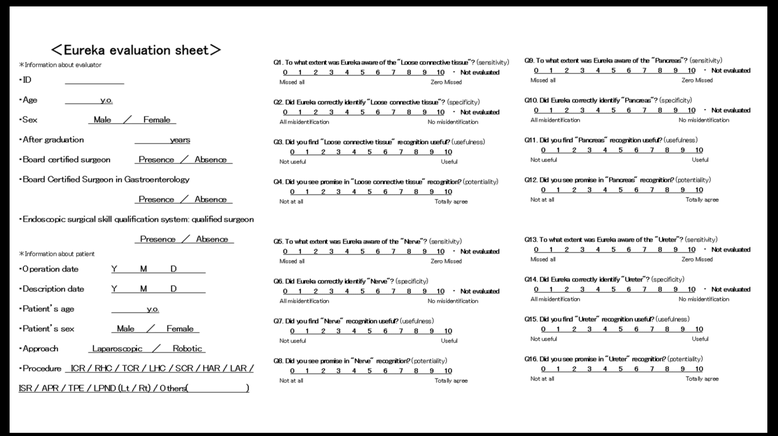
This study was approved by the Ethics Committee of Toranomon Hospital (Approval number: 2103).

• Quantitative evaluation: IOU $= \frac{TP}{TP+FP+FN}$

Dice $= \frac{TP}{TP+1/2(FP+FN)}$

TP: True Positive
FP: False Positive
FN: False Negative

• Qualitative evaluation: Questionnaire survey



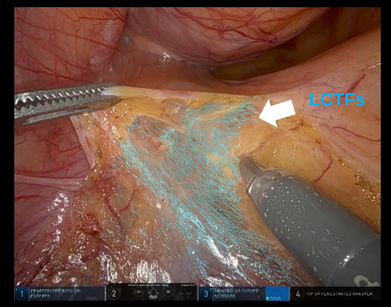
＜Eureka evaluation sheet＞

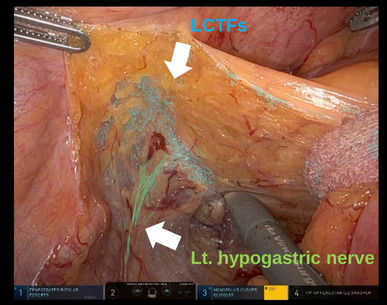
＊Information about evaluator
・ID _____
・Age ____ y.o.
・Sex Male / Female
・After graduation ____ years
・Board certified surgeon Presence / Absence
・Board Certified Surgeon in Gastroenterology Presence / Absence
・Endoscopic surgical skill qualification system: qualified surgeon Presence / Absence

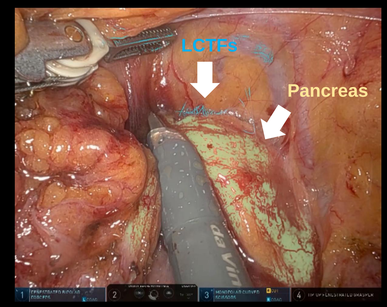
＊Information about patient
・Operation date Y M D
・Description date Y M D
・Patient’s age ____ y.o.
・Patient’s sex Male / Female
・Approach Laparoscopic / Robotic
・Procedure ICR / RHC / TCR / LHC / SCR / HAR / LAR / ISR / APR / TPE / LPND (Lt / Rt) / Others(____)

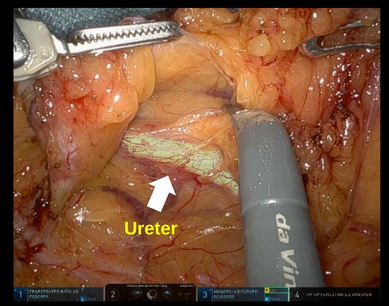
Q1. To what extent was Eureka aware of the “Loose connective tissue”? (sensitivity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (Missed all / Zero Missed)
Q2. Did Eureka correctly identify “Loose connective tissue”? (specificity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (All misidentification / No misidentification)
Q3. Did you find “Loose connective tissue” recognition useful? (usefulness) 0 1 2 3 4 5 6 7 8 9 10 (Not useful / Useful)
Q4. Did you see promise in “Loose connective tissue” recognition? (potentiality) 0 1 2 3 4 5 6 7 8 9 10 (Not at all / Totally agree)
Q5. To what extent was Eureka aware of the “Nerve”? (sensitivity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (Missed all / Zero Missed)
Q6. Did Eureka correctly identify “Nerve”? (specificity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (All misidentification / No misidentification)
Q7. Did you find “Nerve” recognition useful? (usefulness) 0 1 2 3 4 5 6 7 8 9 10 (Not useful / Useful)
Q8. Did you see promise in “Nerve” recognition? (potentiality) 0 1 2 3 4 5 6 7 8 9 10 (Not at all / Totally agree)
Q9. To what extent was Eureka aware of the “Pancreas”? (sensitivity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (Missed all / Zero Missed)
Q10. Did Eureka correctly identify “Pancreas”? (specificity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (All misidentification / No misidentification)
Q11. Did you find “Pancreas” recognition useful? (usefulness) 0 1 2 3 4 5 6 7 8 9 10 (Not useful / Useful)
Q12. Did you see promise in “Pancreas” recognition? (potentiality) 0 1 2 3 4 5 6 7 8 9 10 (Not at all / Totally agree)
Q13. To what extent was Eureka aware of the “Ureter”? (sensitivity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (Missed all / Zero Missed)
Q14. Did Eureka correctly identify “Ureter”? (specificity) 0 1 2 3 4 5 6 7 8 9 10 ・Not evaluated (All misidentification / No misidentification)
Q15. Did you find “Ureter” recognition useful? (usefulness) 0 1 2 3 4 5 6 7 8 9 10 (Not useful / Useful)
Q16. Did you see promise in “Ureter” recognition? (potentiality) 0 1 2 3 4 5 6 7 8 9 10 (Not at all / Totally agree)

Results









Quantitative study

LCTFs	IOU = 0.35 / Dice = 0.52
Nerves	IOU = 0.33 / Dice = 0.45
Pancreas	IOU = 0.53 / Dice = 0.69
Ureter	IOU = 0.43 / Dice = 0.59

Qualitative study (N=40)

Out of 10 points

	LCTFs	Nerves	Pancreas	Ureter
Sensitivity	8.6±1.1	7.5±1.5	7.9±2.2	9.0±1.7
Specificity	8.5±1.1	7.8±1.1	7.6±2.0	5.5±2.7
Usefulness	8.6±1.4	8.5±1.3	8.1±1.1	7.5±1.5
Potential	8.4±1.6	8.5±1.5	8.3±1.2	7.8±1.3

Conclusion

We developed intraoperative organ recognition model using AI in minimal invasive colorectal surgery. This AI models could support surgeon recognition and make colorectal surgery safer.

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