Annals of COLOPROCTOLOGY

Brief Communication

Ann Coloproctol 2024;40(4):412-414
pISSN: 2287-9714 • eISSN: 2287-9722
https://doi.org/10.3393/ac.2023.00815.0116

First clinical experience using augmented intelligence in robotic colorectal surgery with the Senhance robotic platform

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Artificial intelligence (AI) has become an indispensable part of our daily life. In medicine, AI has opened new horizons and revolutionized diagnostic and therapeutic practices, allowing us to overcome challenges related to healthcare costs, disease management, accessibility, and treatment optimization [1]. Currently, AI is primarily used in oncology, pulmonology, orthopedics, hematology, and neurology [2]. The integration of AI into surgery is a reflection of the field's steady evolution, its ever-expanding applications, and notable technical advancements [3].

Although robotic surgery has been utilized in clinical practice for over 20 years, it continues to expand globally. There are a number of robotic platforms with CE approval (CE marking signifies that the manufacturer or importer confirms compliance with European health, safety, and environmental protection standards), including the da Vinci from Intuitive Surgical Inc, Senhance from Asensus Surgical, Versius from CMR Surgical, Hugo RAS from Medtronic, and Dexter from Distalmotion. The Senhance robotic platform is the first and the only to have CE-approved augmented intelligence capabilities. Since March 2023, Klaipeda University Hospital (Klaipeda, Lithuania) has upgraded the Senhance robotic system and incorporated 5 augmented intelligence features into our routine robotic colorectal surgery practice.

From March to November 2023, 29 patients underwent Senhance robotic surgery for colorectal cancer performed by a single surgeon. This procedure utilized 5 features of augmented intelligence: "Digital Tagging," "Smart Zoom," "Go To," "Follow Me," and "Follow Us." The latter 4 are designed to improve control of the camera. "Digital Tagging" allows the surgeon to set up to 9 digital tags to indicate critical structures such as tumors or organ structures to avoid, and/or indicate intraoperative places for clipping/stapling to clearly mark for the assisting team at the table site. "Smart Zoom" employs AI to enable the robot to zoom in and out toward the target area without losing the exact field of vision. "Go To" permits the surgeon to point with either the right or left instrument tip to a region in the anatomy where he or she wants the robot to move the camera; the robot recognizes the tip of the instrument via its augmented intelligence capabilities and moves the camera accordingly. In "Follow Me," with the support of AI, the system helps the surgeon by automatically following 1 of the instruments. "Follow Us" is a feature that uses AI to help the surgeon by automatically following both instruments (the middle of both instruments), zooming in when approximating the tips of the instruments, and zooming out while bringing the instrument tips further apart.

Our experience in using AI is summarized in Table 1, where the results are compared to our data without using AI [4]. The results indicate that there was no significant difference in patient surgical outcomes. However, the AI features have enhanced the teaching process, simplified camera movements, and made them more convenient for the surgeon. Furthermore, according to the

Received: November 21, 2023; Revised: January 13, 2024; Accepted: January 14, 2024
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single surgeon performing these surgeries, "Digital Tagging" was most successfully used to mark the tumor site and important structures (ureter, blood vessel) for teaching residents and students, as well as to improve communication between the scrub nurse and assistant surgeon at the table site. "Smart Zoom" was successfully used to zoom in or out from the operating field and was superior and required less effort compared to the usual camera control using the eye tracking system; this feature was used most frequently. "Go To" was most useful in right hemicolectomy (3-trocar technique and no assistant port [5], as usually 1 instrument, the active one (Senhance ultrasonic), was in the operating field. "Follow Us" best assisted surgery when performing mobilization of the sigmoid colon or performing total mesorectal excision dissection in the avascular plain, when one instrument in the operating field was used for tracking the tissues and the second for dissection. "Follow Me" was used in both right hemicolectomy and sigmoid or rectal resections, eliminating the need to use eye tracking and making camera movements timelier, when only 1 of the instruments was mostly seen in the operative field (we could not illustrate the "Smart Zoom" tool in a picture, as this is a dynamic tool when the robot zooms in and out toward the target area without losing the exact field of vision) (Fig. 1).

The Senhance robotic platform was first introduced under the name Telelap ALF-X in 2012 [6], and the first report on clinical experiences was published in 2015 [7]. This platform had several features distinct from the only other available system at that time (da Vinci): haptic sensation, camera control with an eye tracker, an open console, separate robotic arms, and multiple-use instruments [8]. It is still the only robotic platform offering 3-mm robotic instruments [9], which is obviously attractive for pediatric surgery. The Senhance robotic system received CE certification for the first 3 augmented intelligence features ("Follow Me," "Smart Zoom," "Go To") in January 2021, followed by approval of the next ones ("Follow Us," "Digital Tags," and "Measurement") in January 2023. We implemented them into routine colorectal robotic surgery in early March 2023. This was a small, but notable

Table 1. Experience with augmented AI for colorectal surgery

Variable	With AI (n = 29)	Without AI (n = 57)
Sex		
Male	18 (62.1)	29 (50.9)
Female	11 (37.9)	28 (49.1)
Age (yr)	58.1 ± 5.2 (36–85)	61.7 ± 6.2 (23–84)
Length of surgery (min)	160.5 ± 41.3 (100–260)	194.4 ± 57.8 (90–380)
Cancer stage[a]		
I	8 (27.6)	14 (24.6)
II	9 (31.0)	14 (24.6)
III	12 (41.4)	17 (29.8)
IV	0 (0)	2 (3.5)
Cancer location[a]		
Rectum	15 (51.7)	26 (45.6)
Colon	14 (48.3)	21 (36.8)
Surgery performed		
TME	6 (20.7)	9 (15.8)
Partial TME	6 (20.7)	11 (19.2)
Sigmoid colectomy	7 (24.2)	10 (17.5)
Right hemicolectomy	6 (20.7)	16 (28.1)
Transanal TME	2 (6.9)	4 (7.0)
Abdominoperineal resection	1 (3.4)	5 (8.8)
Subtotal colectomy	1 (3.4)	1 (1.8)
Anterior resection with partial mesorectal excision and end colostomy (Hartmann type)	0 (0)	1 (1.8)
Hospital stay (day)	5.2 ± 3.2 (4–15)	8.6 ± 6.2 (3–48)
Complication (Clavien-Dindo grade)	5 (17.2)	7 (12.3)
I	0 (0)	1 (1.8)
II	3 (10.3)	2 (3.5)
IIIa	0 (0)	1 (1.8)
IIIb	2 (6.9)	3 (5.3)

Values are presented as number (%) or mean ± standard deviation (range).
AI, artificial intelligence; TME, total mesorectal excision.
[a]Ten cases (17.5%) in without AI group were benign.

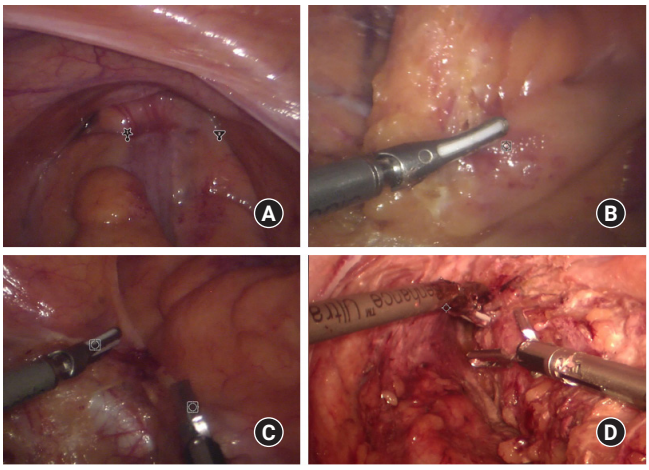

Fig. 1. Tools of artificial intelligence. (A) "Digital Tags" (star and triangle) have been set to mark the lateral margins of the upper rectal cancer. (B) "Go To" tool was activated and camera placed the marked tip of the instrument into the center of the screen and now tool will automatically switch off. (C) "Follow Us" tool was activated and camera placed both marked instruments into the center of the screen and will keep them in the center and follow movements of the both as long as the tool is activated. (D) "Follow Me" tool is initiated and after its activation camera will place the marked tip of the instrument into the center of the screen and will keep it in the center and follow its movements as long as the tool is activated.

step toward the future of robotics and AI. The overall integration of AI into surgical robotic and autonomous systems is massive and continues to progress toward even broader clinical applications [10]. It goes without saying that, in the near future, we will confront a multitude of ethical issues associated with the incorporation of AI into robotic surgery [11].

In conclusion, we report, for the first time, the use of augmented intelligence features in robotic Senhance colorectal surgery. Further developments in robotic surgery and the further implementation of augmented intelligence/AI into this field will open new horizons in this minimal-access approach to surgery, likely offering our patients increased precision, higher efficacy, and finally, better outcomes.

ARTICLE INFORMATION

Conflict of interest

Audrius Dulskas is an Editorial Board member of *Annals of Coloproctology*, but was not involved in the reviewing or decision process of this manuscript. No other potential conflict of interest relevant to this article was reported.

Funding

None.

Author contributions

Conceptualization: all authors; Writing–original draft: NES, Writing–review & editing: all authors. All authors read and approved the final manuscript.

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https://doi.org/10.3393/ac.2023.00815.0116