RESEARCH ARTICLE

4K ultra HD technology reduces operative time and intraoperative blood loss in colorectal laparoscopic surgery [version 1; peer review: 2 approved]

Giulio M. Mari [1], Jacopo Crippa[2], Pietro Achilli [2], Angelo Miranda[1], Letizia Santurro[1], Valentina Riggio[1], Martino Gerosa[1], Pietro Ascheri[1], Giuseppe Cordaro[1], Andrea T.M. Costanzi[1], Dario Maggioni[1]

[1]General Surgery Department, Desio Hospital, ASST Monza, Desio, MB, Italy
[2]General Surgery Residency Program, University of Milan, Milan, Italy

v1 **First published:** 11 Feb 2020, **9**:106
https://doi.org/10.12688/f1000research.21297.1
Latest published: 11 Feb 2020, **9**:106
https://doi.org/10.12688/f1000research.21297.1

Abstract

Background: HD systems are routinely used in laparoscopic surgery, 4K ultra HD monitors are mainly available within specialized, high-volume laparoscopic centers. The higher resolution of 4K ultra HD video could upgrade the surgical performance improving intraoperative and post-operative outcomes.

Methods: We performed a retrospective comparative analysis of intraoperative parameters and post-operative outcomes in a cohort of patients operated on for elective laparoscopic procedures for colo-rectal cancer during two different time frames: 2017 procedures performed using the Visera Elite full HD technology (® Olympus America, Medical) and the 2018 procedures performed the Visera 4K Ultra HD System (® Olympus America, Medical).

Results: There was a statistically significant reduction in operative time in patients operated on with the 4K ultra HD technology compared to HD technology ($p < 0.05$). Intraoperative blood loss was significantly reduced in patients operated in 2018 ($p < 0.05$). There were no statistically significant differences in complication rate and postoperative outcomes between the two groups.

Keywords

Colorectal surgery, laparoscopy, 4K full HD

Open Peer Review

Reviewer Status ✓ ✓

	Invited Reviewers	
	1	**2**
version 1 11 Feb 2020	✓ report	✓ report

1 **Matteo Uccelli**, Policlinico San Marco, Bergamo, Italy

2 **Isacco Montroni**, Infermi Hospital-Faenza, Faenza, Italy

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding author: Pietro Achilli (pietro.achilli89@gmail.com)

Author roles: Mari GM: Conceptualization, Formal Analysis, Supervision, Writing – Original Draft Preparation; **Crippa J**: Conceptualization, Resources, Validation, Writing – Original Draft Preparation; **Achilli P**: Methodology, Supervision, Writing – Review & Editing; **Miranda A**: Data Curation, Investigation; **Santurro L**: Data Curation, Methodology, Supervision; **Riggio V**: Conceptualization, Data Curation, Writing – Review & Editing; **Gerosa M**: Data Curation, Formal Analysis, Supervision; **Ascheri P**: Formal Analysis, Investigation, Project Administration, Resources, Software, Validation; **Cordaro G**: Data Curation, Visualization, Writing – Review & Editing; **Costanzi ATM**: Conceptualization, Validation, Writing – Review & Editing; **Maggioni D**: Conceptualization, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

How to cite this article: Mari GM, Crippa J, Achilli P *et al.* **4K ultra HD technology reduces operative time and intraoperative blood loss in colorectal laparoscopic surgery [version 1; peer review: 2 approved]** F1000Research 2020, **9**:106 https://doi.org/10.12688/f1000research.21297.1

First published: 11 Feb 2020, **9**:106 https://doi.org/10.12688/f1000research.21297.1

Introduction

Laparoscopic surgery provides several intra- and post-operative advantages such as improved cosmesis, less post-operative pain and faster recovery compared to open surgery[1]. The development of new technologies has allowed laparoscopic surgery to become faster and safer. In particular, the quality of digital imaging has played a key role in the development of such procedures[2]. The association between quality of vision and surgical outcome is very tight. Improving the image quality allows the sharpness of laparoscopic surgery to be fully expressed. The clear view of the anatomical landmarks can improve the accuracy of dissection, permitting dissection of the lymphatic and nervous structures, which represent a crucial aspect of colorectal surgery[3]. Furthermore, the improved visualization of vascular structures and the better definition of adipose tissues may avoid intraoperative bleeding and reduce operative time, resulting in reduced surgical stress for the patient and potentially decreased complication rate[4].

Recently, several new imaging technologies, such as three-dimensional (3D)/high-definition (HD) stereovision and high-resolution two-dimensional (2D)/4K monitors have been made available to laparoscopic surgeons[5]. However, it is still unclear to what extent these technologies can actually improve surgical performance[6].

Nowadays, HD systems are routinely used in laparoscopic surgery, while 4K ultra HD monitors are mainly available within specialized, high-volume laparoscopic centers[7,8]. The higher resolution of 4K ultra HD video could upgrade the surgical performance by improving depth perception, dissection precision, and bleeding control, but no study has yet provided a good evidence to sustain this finding. For this reason, we designed the present study to compare surgical intraoperative and post-operative parameters in patients operated on for colorectal cancer either with 4K ultra HD technology or a standard HD vision.

Methods

Ethical statement

Ethical approval was sought for the present study and the need for approval was waived by the ASST-MONZA ethics committee. According to the ASST-MONZA hospital regulation and to the local ethics committee, retrospective studies which do not involve a clinical intervention do not need to undergo the institutional review board ethical approval process. Written informed consent for reanalysis of the data and revision of clinical images and videos was taken from all the patients at the day of the inpatient visit one week before the surgical intervention date, as per routine practice in our institution[9].

Patients

We performed a retrospective analysis of consecutive adult patients operated on for elective laparoscopic procedures for colorectal cancer during two different time frames: 2017 procedures performed using the Visera Elite full HD technology (® Olympus America, Medical) and the 2018 procedures performed the Visera 4K Ultra HD System (® Olympus America, Medical). Patients were divided into groups according to optic technology used. All the operations were performed in one hospital with the same operating room settings during the study period, except for the optic technology used. Patients were excluded from the analysis if they were submitted to surgery for benign disease, for palliative resections or in an emergency setting.

Surgical procedures

All procedures in 2017 and 2018 were performed with the same hybrid energy device. Surgical procedures were: laparoscopic right hemicolectomy (LRH) with intra-corporeal anastomosis; laparoscopic left hemicolectomy (LLH) with the anastomosis performed according to the Knight-Griffen technique; laparoscopic rectal anterior resection (LRAR) with the anastomosis performed according to the Knight-Griffen technique and loop ileostomy[10]. All procedures were performed by four colorectal laparoscopic surgeons, each of them with more than 100 totally laparoscopic procedures involving right colectomies, left colectomies and rectal anterior resections performed before 2017. Operating surgeons were asked to provide feedback on the ability of 4K ultra HD technology to visualize anatomical structures with respect to the HD technology, and regarding the eye fatigue perceived at the end of a procedure with 4K ultra HD technology over the HD technology. Feedback was collected through a written survey that was filled out at the end of each surgical procedure. This survey was routinely completed by the staff surgeons at the end of every minimally invasive procedure as part of the surgical intervention notetaking. The surveys were then retrieved form the electronic medical records.

Data collection

Data were derived from the prospectively maintained electronic database of medical records of our institution. This database contained demographic information, admission dates and discharge diagnoses of each patient undergoing surgery for colorectal cancer. Electronic medical records contained details of every inpatient hospitalization at our institution, every outpatient visit to the clinic or emergency department, as well as every laboratory result and all data concerning the postoperative course after surgery. Specific items in the database are described in Table 2. Time of surgery, blood loss, conversion rate, as well as complication rate according to Clavien-Dindo (CD) classification, were analyzed[11]. We also focused on CD complication rate for major complications (CD major or equal to 3).

Statistical analysis

Descriptive statistics for categorical variables were reported as frequencies (%), continuous variables as mean (standard deviation) or median (interquartile range (IQR)) according to distribution. The Chi-square[2] test was used to compare categorical variables. All statistical tests were two-sided and a level of less than or equal to 0.05 was used to indicate statistical significance. Data analysis was performed with Statistical Software for the Social Sciences (SPSS) Advanced Statistics 22 (IBM Software Group, 200 W. Madison St., Chicago, IL; 60,606 USA).

Results

There were no statistically significant differences in terms of baseline characteristics between groups[9]. Table 1 describes patient characteristics.

In 2017, a total of 28 LHRs, 38 LLHs and 28 LRARs were performed, while there were 30 LRHs, 44 LLHs and 23 LRARs in 2018. The overall complication rate according to CD classification was 21.2% (20/94) in 2017 and 17.5% (17/97) in 2018 (p>0.05). The rate of major complications (CD ≥ 3) was 6.3% (6/94) in 2017 vs 4.1% (4/97) in 2018 (p>0.05). In particular, there were no statistically significant differences in anastomotic leak rate, post-operative bleeding rate, mortality rate and readmission rate between groups. Mean surgical time was statistically significantly shorter with 4K ultra HD technology than HD technology ($p < 0.05$). Intraoperative blood loss was statistically significantly reduced in patients operated on in 2018 ($p < 0.05$) (Table 2).

Figure 1A shows the ileocolic vein and the inferior mesenteric vein dissected during a right hemicolectomy with complete mesocolic excision. Figure 1B shows the middle colic vein

Table 1. Patient characteristics.

	Total	2017	2018	p
N	191	94	97	
Male	114	52	62	ns
Female	76	42	34	ns
Median age (range)	68 (31–97)	68 (38–97)	70 (31–94)	ns
Mean BMI ± SD	25.0 ± 3.5	26.0 ± 3.8	25.5 ± 2.9	ns
ASA I	62	32	30	ns
ASA II	85	41	44	ns
ASA III	35	17	18	ns
ASA IV	9	4	5	ns
LRH	58	28	30	ns
LLH	82	38	44	ns
LRAR	51	28	23	ns
Stage I	55	28	27	ns
Stage II	66	31	35	ns
Stage III	61	31	30	ns
Stage IV	9	4	5	ns

BMI, body mass index; SD, standard deviation; ASA, American Society of Anesthesiologists' physical status classification; LLH, laparoscopic left hemicolectomy; LRH, laparoscopic right hemicolectomy; LRAR, laparoscopic rectal anterior resection.

Table 2. Intraoperative parameters and short-term outcomes.

	Total	2017	2018	p
N	191	94	97	
Complication rate	37/191 (19.3%)	20/94 (21.2%)	17/97 (17.5%)	ns
CD ≥ 3	10/191 (5.2%)	6/94 (6.3%)	4/97 (4.1%)	ns
Leak rate	7/191 (3.7%)	4/94 (4.2%)	3/97 (3.0%)	ns
P.O. bleeding	3/191 (1.5%)	2/94 (2.1%)	1/97 (1.0%)	ns
Readmission rate	21/191 (11.0%)	10/94 (10.6%)	11/97 (11.3)	ns
Mortality rate	1/191 (0.5%)	1/94 (1.0%)	0/97 (0.0%)	ns
Mean operative time (min) ± SD	199 ± 49.7	209 ± 51.4	192.7 ± 48.3	< 0.05
Mean blood loss (ml) ± SD	43 ± 12	48 ± 15	40 ± 18	< 0.05

CD, Clavien-Dindo; P.O., post-operative; SD, standard deviation.

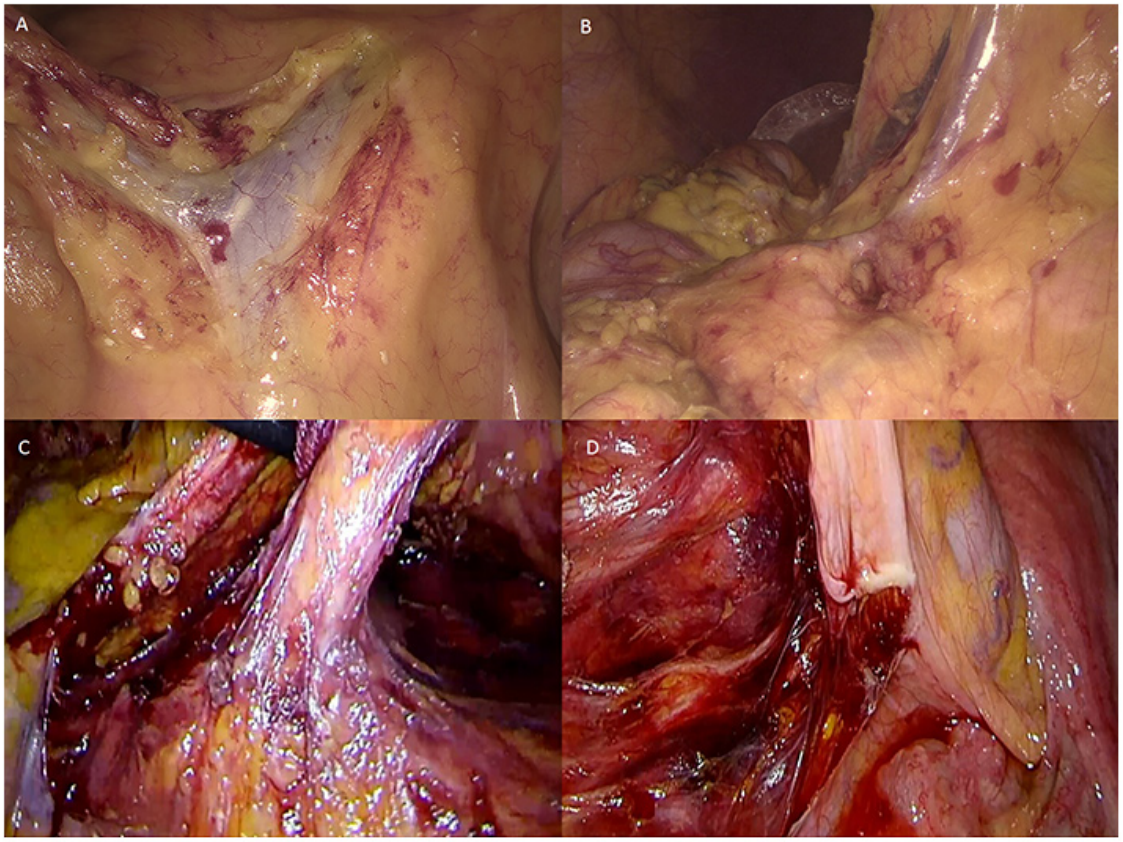

Figure 1. A) Ileocolic vein and inferior mesenteric vein (HD technology). **B**) Middle colic vein (4K ultra HD technology). **C**) Gerota's fascia and inferior mesenteric artery (HD technology). **D**) Hypogastric plexus at the origin of the inferior mesenteric artery (4K ultra HD technology). Images were obtained retrospectively from the video electronic library of our institution, which contains records of all minimally invasive procedures of patients who gave consent for publication of the images for educational or research purposes.

isolated during the same procedure performed with 4K ultra HD technology. Figure 1C shows the Gerota fascia and the inferior mesenteric artery isolated during a left hemicolectomy with HD technology. Figure 1D shows the hypogastric plexus at the origin of the inferior mesenteric artery spared during anterior rectal resection with 4K ultra HD technology.

Discussion

The main finding of our study is the statistically significant reduction in surgical time with the 4K ultra HD technology compared to normal HD technology. Intraoperative blood loss was also statistically significantly reduced in patients operated on with 4K ultra HD technology.

4K ultra HD monitors were introduced in our surgical department in January 2018, replacing full HD technology for major colorectal laparoscopic procedures. Accurate visualization of the anatomical structures is crucial during laparoscopic procedures. Recognizing the vascular structures, their divisions and their course within the mesocolic fat tissue is of fundamental importance in oncological surgery[12]. Lymph node visualization along the course of the vessels and the ability to remove them without encountering troublesome bleeding allow a more precise dissection[13].

Cutting edge technologies like 4K ultra HD allow the surgeon to be even more minimally invasive. Abderlahman *et al.* reported on the importance of the quality of 4K ultra HD images in reducing mistakes in structure identification[1]. Moreover, during left sided colorectal laparoscopic procedures, a precise visualization of the autonomic nerves is related to a better preservation of the genitourinary function. Especially for LRARs, both preservation of the autonomic nerves and avoiding injury to the mesorectum are essential for functional outcomes[14].

The results we reported show how, following the introduction of a 4K technology, operating time for the same operations performed by the same surgeons decreased significantly. This may lead to lower operating room costs, as well as to the clinical benefits of a reduction in the peri-operative stress that patients are subjected to due to the duration of surgery and use of anesthesia[15]. The significant reduction of intraoperative blood loss in the two groups could be related to the improved capability in recognizing vascular structures that 4K ultra HD permits.

Although it was not scientifically investigated in the present work, the subjective impressions of the operating surgeons are

important when a new technology is introduced. All participating surgeons subjectively reported a much more detailed image with the 4K ultra HD technology. They all depicted a clearer understanding of the anatomical structures and of the surgical planes. In LRARs above all, the advantages of the 4K ultra HD view have been particularly enhanced, given the complexity of the anatomical field[16,17]. All operators reported ending procedures with less eye fatigue using 4K technology, although this could not be measured. The eye fatigue was reported to be minimal during the procedures performed in 2018. This finding is important when related to the fact that in almost all cases, the surgeon has to perform three or four procedures in the same day. Moreover, the 4K ultra HD technology could help in reducing the inevitable eye fatigue that aging brings[18].

This study has several biases, beside its retrospective nature. The estimation of the validity of a technology cannot be entrusted only to the operative time required and instead consists of much more complex analysis. However, the reduction in surgical time is a reliable assessment of the technological improvement reached. The subjective reports of the intraoperative perception of the operating surgeons were not structured in intelligible questionnaires. Further efforts should be made to produce a specific tool to investigate the quality of the devices used in mini-invasive surgery.

Conclusions

4K ultra HD technology applied to colorectal oncologic laparoscopic procedures is safe and effective in reducing surgical time and minimizing intraoperative blood loss compared to normal HD technology.

Data availability

Underlying data

Zenodo: 4K Ultra HD Technology Reduces Operative Time And Intra Operative Blood Loss In Colorectal Laparoscopic Surgery. https://doi.org/10.5281/zenodo.3603342[9]

This project contains the following underlying data:

- Patients characteristics and surgical outcomes.xls
- Original surgical image files in JPG format

Extended data

Zenodo: 4K Ultra HD Technology Reduces Operative Time And Intra Operative Blood Loss In Colorectal Laparoscopic Surgery. https://doi.org/10.5281/zenodo.3603342[9]

This project contains the following extended data:

- Informed consent.pdf (copy of consent form in Italian)
- Informed consent (english version).pdf (copy of consent form in English)

Consent

Written informed consent for publication of the patients' data and clinical images was obtained from each patient involved.

References

1. Abdelrahman M, Belramman A, Salem R, *et al.*: **Acquiring basic and advanced laparoscopic skills in novices using two-dimensional (2D), three-dimensional (3D) and ultra-high definition (4K) vision systems: A randomized control study.** *Int J Surg.* 2018; **53**: 333–338.
PubMed Abstract | Publisher Full Text
2. Harada H, Kanaji S, Hasegawa H, *et al.*: **The effect on surgical skills of expert surgeons using 3D/HD and 2D/4K resolution monitors in laparoscopic phantom tasks.** *Surg Endosc.* 2018; **32**(10): 4228–4234.
PubMed Abstract | Publisher Full Text
3. Pai A, Melich G, Marecik SJ, *et al.*: **Current status of robotic surgery for rectal cancer: A bird's eye view.** *J Minim Access Surg.* 2015; **11**(1): 29–34.
PubMed Abstract | Publisher Full Text | Free Full Text
4. Kinugasa Y, Sugihara K: **Topology of the fascial structures in rectal surgery: Complete cancer resection and the importance of avoiding autonomic nerve injury.** *Semin Colon Rectal Surg.* 2010; **21**(2): 95–101.
Publisher Full Text
5. Buia A, Stockhausen F, Filmann N, *et al.*: **2D vs. 3D imaging in laparoscopic surgery-results of a prospective randomized trial.** *Langenbecks Arch Surg.* 2017; **402**(8): 1241–1253.
PubMed Abstract | Publisher Full Text
6. Sugawara M, Kanazawa M, Mitani K, *et al.*: **SMPTE Periodical Ultrahigh-definition video system with 4000 scanning lines.** *SMPTE Motion Imaging J.* 2003; **112**(10–11): 339–346.
Publisher Full Text
7. Yamashita H, Aoki H, Tanioka K, *et al.*: **Ultra-high definition (8K UHD) endoscope: our first clinical success.** *Springerplus.* 2016; **5**(1): 1445.
PubMed Abstract | Publisher Full Text | Free Full Text
8. Olympus: **VISERA 4K UHD System**.
Reference Source
9. Mari G, Crippa J, Achilli P, *et al.*: **4K Ultra HD Technology Reduces Operative Time And Intra Operative Blood Loss In Colorectal Laparoscopic Surgery**. 2019.
http://www.doi.org/10.5281/zenodo.3603342
10. Griffen FD, Knight CD Sr, Whitaker JM, *et al.*: **The double stapling technique for low anterior resection. Results, modifications, and observations.** *Ann Surg.* 1990; **211**(6): 745–51; discussion 751–2.
PubMed Abstract | Publisher Full Text | Free Full Text
11. Dindo D, Demartines N, Clavien PA: **Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey.** *Ann Surg.* 2004; **240**(2): 205–13.
PubMed Abstract | Publisher Full Text | Free Full Text
12. Shen Z, Cheng J, Yin M, *et al.*: **Evaluation of anatomical landmarks for transanal total mesorectal excision based on MRI.** *Asian J Surg.* 2019; **42**(6): 667–673.
PubMed Abstract | Publisher Full Text
13. Lee CHA, Wilkins S, Oliva K, *et al.*: **Role of lymph node yield and lymph node ratio in predicting outcomes in non-metastatic colorectal cancer.** *BJS Open.* 2019; **3**(1): 95–105.
PubMed Abstract | Publisher Full Text | Free Full Text
14. Mari GM, Crippa J, Cocozza E, *et al.*: **Low Ligation of Inferior Mesenteric Artery in Laparoscopic Anterior Resection for Rectal Cancer Reduces Genitourinary Dysfunction: Results From a Randomized Controlled Trial (HIGHLOW Trial).** *Ann Surg.* 2019; **269**(6): 1018–1024.
PubMed Abstract | Publisher Full Text
15. Graziola E, Elena G, Gobbo M, *et al.*: **[Stress, hemodynamic and immunological responses to inhaled and intravenous anesthetic techniques for video-assisted laparoscopic cholecystectomy].** *Rev Esp Anestesiol Reanim.* 2005; **52**(4): 208–16.
PubMed Abstract
16. Ferrara M, Kann BR: **Urological Injuries during Colorectal Surgery.** *Clin Colon Rectal Surg.* 2019; **32**(3): 196–203.
PubMed Abstract | Publisher Full Text | Free Full Text
17. Spadaro S, Karbing DS, Mauri T, *et al.*: **Effect of positive end-expiratory pressure on pulmonary shunt and dynamic compliance during abdominal surgery.** *Br J Anaesth.* 2016; **116**(6): 855–61.
PubMed Abstract | Publisher Full Text
18. Fergo C, Burcharth J, Pommergaard HC, *et al.*: **Age is highly associated with stereo blindness among surgeons: a cross-sectional study.** *Surg Endosc.* 2016; **30**(11): 4889–4894.
PubMed Abstract | Publisher Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔

Version 1

Reviewer Report 30 July 2020

https://doi.org/10.5256/f1000research.23454.r59927

✔ **Isacco Montroni**
Colorectal Surgery, Infermi Hospital-Faenza, Faenza, Italy

The abstract is clear and well structured according to the guidelines of the journal.
The introduction properly explains how technology and surgery have to get along improving the surgical outcomes. However, I think it is crucial that the results provided should be explained in a scientific way. From this point of view, this article is a quite good attempt towards this direction.

Looking at the extended materials attached data are well collected and presented in a precise way. I believe that having the chance to see the original data is a great opportunity for whoever wants to read an article and therefore I congratulate with the journal and the authors.

The two cohorts of patients undergoing elective colo-rectal laparoscopic procedures are homogeneous in terms of tumor location, age, and sex and therefore are fully comparable. The authors are assuming that the introduction of new technology could have led to better surgical outcomes. The way they tried to prove it is a retrospective analysis that does not actually provide the best level of evidence. However, when you compare two different types of technologies, developing an RCT is really difficult and it could also be un-ethical.

Taking a look at the results the authors depicted a reduction in blood loss and surgical time in favour of patients operated with the new technology. This result can be of some interest in its field even though cannot be considered conclusive of the comparison (as stated by the authors in the limitations).
I think another important issue scoring a point for this trial is that it is not sponsored by the company providing the 4k technology. Usually, this kind of trial comes straight from the pharma. Here instead this bias can be solved by the fact that the authors conducted the study independently and therefore without having pressures from the providing company.
We do not have to forget that the connection between clinical research and industry has lots of precious points but also lots of grey zones. The attempt done by the authors is from this point of view of great value and should be taken in serious consideration.

From a purely practical point of view:

- This study is well understandable.
- Methods are clear and complete.
- Results are well explained and as previously said, they come together with the full amount of data.
- Statistics is good enough.
- The discussion could be implemented but still, there are not so many materials in the literature to compare these results with. This latter also shows how this simple study could be of some value/novelty.
- I consider the study suitable for indexing.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Colorectal mini-invasive surgery.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 29 July 2020

https://doi.org/10.5256/f1000research.23454.r61891

Matteo Uccelli
Department of Surgery, S.I.C.OB. (Italian Society of Bariatric Surgery) Referral Center for Bariatric Surgery, San Donato Group, Policlinico San Marco, Bergamo, Italy

The authors present a retrospective analysis of a cohort of patients operated on for elective laparoscopic procedures for colo-rectal cancer during two different time frames. The main change reported among the two time periods is the introduction of a new visual technology.
From this point of view, we can call this a “before and after trial”. The information provided is therefore not comparable with an eventual RCT since the introduction of new technology makes the old one un-applicable. Thus the data provided, although coming from a retrospective analysis can be reliable.

The surgical volume reported are adequate to consider the Unit where the study was performed a “high volume unit” solving the possible bias of the learning curve.

The main conclusion reached by the authors is that operative times could be reduced by the introduction of a 4K technology. Such a relationship between technology and surgical time is interesting although partial and it is commented by the authors in the limitation assuming that “the estimation of the validity of a technology cannot be entrusted only to the operative time required, but consists of a much more complex analysis. However, the reduction in surgical time is a reliable assessment of the technological improvement reached”.
Also, the idea of structuring a tool to inquire about the surgeon’s perception when introducing a new technology is relevant and should be taken into consideration for future studies.

Reduction in intraoperative blood loss in the 4k patients is an important finding even if the incidence of post-operative bleeding is substantially equal in the two groups. From this point of view, the blood loss data correlates more with a precise dissection more than with the complication rate, scoring a point for the 4k technology.
This trial is simple but clear. It describes the comparison in terms of surgical outcomes of two different visual laparoscopic technology in two similar time frames. It is an interesting attempt to evaluate the relationship between technical means and surgical activity which is oftentimes put aside.
Statistical analysis are clear and well exposed.
The background is fluid and contextualized.
The discussion is clear and it does not assume more than what it should according to the nature of the trial itself. Limitations are reported and clearly understandable.
As previously reported I think that this trial should be accepted for publication.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Colorectal laparoscopic surgery

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.