Surg Endosc (2017) 31:4496–4504
DOI 10.1007/s00464-017-5504-2

Training value of laparoscopic colorectal videos on the World Wide Web: a pilot study on the educational quality of laparoscopic right hemicolectomy videos

V. Celentano[1] · M. Browning[1] · C. Hitchins[1] · M. C. Giglio[2] · M. G. Coleman[1]

Received: 3 August 2016 / Accepted: 8 March 2017 / Published online: 4 April 2017

Abstract

Introduction Instructive laparoscopy videos with appropriate exposition could be ideal for initial training in laparoscopic surgery, but unfortunately there are no guidelines for annotating these videos or agreed methods to measure the educational content and the safety of the procedure presented. Aim of this study is to systematically search the World Wide Web to determine the availability of laparoscopic colorectal surgery videos and to objectively establish their potential training value.

Methods A search for laparoscopic right hemicolectomy videos was performed on the three most used English language web search engines Google.com, Bing.com, and Yahoo.com; moreover, a survey among 25 local trainees was performed to identify additional websites for inclusion. All laparoscopic right hemicolectomy videos with an English language title were included. Videos of open surgery, single incision laparoscopic surgery, robotic, and hand-assisted surgery were excluded. The safety of the demonstrated procedure was assessed with a validated competency assessment tool specifically designed for laparoscopic colorectal surgery and data on the educational content of the video were extracted.

Results Thirty-one websites were identified and 182 surgical videos were included. One hundred and seventy-three videos (95%) detailed the year of publication; this demonstrated a significant increase in the number of videos published per year from 2009. Characteristics of the patient were rarely presented, only 10 videos (5.4%) reported operating time and only 6 videos (3.2%) reported 30-day morbidity; 34 videos (18.6%) underwent a peer-review process prior to publication. Formal case presentation, the presence of audio narration, the use of diagrams, and snapshots and a step-by-step approach are all characteristics of peer-reviewed videos but no significant difference was found in the safety of the procedure.

Conclusions Laparoscopic videos can be a useful adjunct to operative training. There is a large and increasing amount of material available for free on the internet, but this is currently unregulated.

Keywords Laparoscopic surgery · Colorectal surgery · Surgical training · Distance learning · Surgical videos · Right hemicolectomy

The traditional apprentice model for surgeons in training requires sufficient opportunities and time to learn surgical skills under the direction and supervision of an experienced trainer [1]. The operating room represents an essential learning environment which cannot be fully replaced, but with duty hour restrictions, heightened concerns for patient safety and increased levels of staff supervision, surgical trainees may have less autonomy and educational time in the operating theatre. With the decrease in opportunities to experience surgery at many teaching hospitals [2, 3], the problem of how to make education more efficient has taken on greater importance.

Electronic supplementary material The online version of this article (doi:10.1007/s00464-017-5504-2) contains supplementary material, which is available to authorized users.

✉ V. Celentano
valeriocelentano@yahoo.it

[1] Colorectal Unit, Plymouth Hospitals NHS Trust, Plymouth, UK

[2] Department of Clinical Medicine and Surgery, School of Medicine, Federico II University, Naples, Italy

Laparoscopic surgery has become widespread and it has been increasingly applied in colorectal surgery [4]. However, despite the evidence for the clinical benefits of laparoscopic colorectal surgery and its oncologic safety [5], the dissemination of this technique has been hesitant, due to the technical complexity of the procedure and a prolonged learning curve [6].

Performing advanced laparoscopic procedures requires dedicated surgical skills [7] to overcome specific technical difficulties which include two-dimensional vision with loss of depth perception, less range of motion of the instruments, impaired tactile sensation, and the disparity between visual and proprioceptive feedback known as the fulcrum effect [8]. Such challenges in surgical education require new learning tools to try and overcome the time constraints [9, 10].

Audiovisual presentations are recognized in the medical field as important educational materials; thus, they are used to communicate information effectively to clinicians, patients, and students [11–14].

Fortunately, laparoscopic surgery lends itself to the production of audiovisual educational materials. Current endoscopy systems are in fact equipped with video-recording devices, making it easy to capture high-quality images in a digital format. The video recording of the procedure shows exactly what the surgeon is viewing providing surgical trainees with essential information regarding anatomy and the different steps of the operation.

Instructive laparoscopy videos with appropriate exposition could be ideal for initial training in laparoscopic surgery [15], but unfortunately there are no guidelines for annotating these videos or agreed methods to measure the educational content and the safety of the procedure presented.

Uploading videos and sharing information on open access media broadcasting channels requires minimal technical skills and is now widely used by individuals and organizations, who wish to reach out to the global audience and share information about scientific issues [16, 17].

Recent studies suggest that these sources hold promise as educational tools for scientific disciplines [18], utilizing sophisticated visual didactic materials. Due to these characteristics, many videos of laparoscopic surgery procedures have been uploaded on these channels and many viewers are watching them [19].

The trustworthiness of a large proportion of publicly available files remains questionable as not all videos are authoritative and may not show techniques based on solid evidence. They may contain incorrect or misleading promotional information [20, 21].

Laparoscopic surgical videos could represent an educational resource for colorectal surgery trainees. This study aims to systematically search the World Wide Web to determine the availability of laparoscopic colorectal surgery videos and to objectively establish their potential training value in terms of safety of the procedure demonstrated and the quality of the educational content presented.

Methods

Search strategy

After the development of a review protocol, a broad search for laparoscopic right hemicolectomy videos was independently performed by two authors on the three most used English language internet search engines (Google.com, Bing.com, and Yahoo.com) using the keywords "laparoscopic colorectal video" and "right hemicolectomy video."

The first 100 results of each search were considered and all websites containing surgical videos were assessed. Sponsored links, advertisements, and surgeons' private practice websites were not considered. Moreover, in order to include as many websites as possible, reflecting the actual use of internet by trainees, a survey among 25 local trainees was performed to identify further websites for inclusion.

All retrieved websites were systematically searched for laparoscopic right hemicolectomy videos using the following search terms: right hemicolectomy, right colectomy, laparoscopic colectomy, minimally invasive colectomy, keyhole colectomy, and laparoscopic colorectal surgery. When a browse function of the available videos was present on the website, right hemicolectomy videos were retrieved manually. The last search was run on 13, November 2015.

Eligibility criteria and video selection

All videos of laparoscopic right hemicolectomy with an English language title were included.

Open surgery, single incision laparoscopic surgery (SILS), robotic, and hand-assisted surgery videos were excluded, as were videos from fee charging websites. Videos only demonstrating the anastomosis or the specimen extraction technique or the use of a new device for a single step of the procedure were excluded as were videos of combined surgical procedures.

Two reviewers independently assessed the videos for eligibility at title level. The inter-reviewer's agreement was explored through the Cohen's Kappa statistic. In case of discrepancies, a third author was consulted and agreement was reached by consensus.

When the same author and institution published the same video on different websites, only the most recent video was evaluated.

Data extraction

Two authors independently retrieved the data from each included video completing an electronic database with the records detailed in Table 1.

Assessment of the safety of the recorded procedure: laparoscopic competency assessment tool (LCAT)

In order to assess the safety of the demonstrated procedure, a validated competency assessment tool specifically designed for laparoscopic colorectal surgery was used [22]. The laparoscopic competency assessment tool (LCAT) is a task-specific marking sheet for the assessment of technical surgical skills in laparoscopic colorectal surgery. It is designed to assess the surgeon's performance by watching a live, live-streamed or recorded operation. The procedure is divided into four different tasks: each task has 4 different items which are scored based on the safety and effectiveness of the procedure. Task Step 1: "Exposure" begins with the first port insertion and ends when the exposure of the operating field is completed and dissection commences. Low scores are assigned in case of forceful and potentially dangerous port insertion as for ineffective grasping of the bowel and mesentery and exposure of the operative field. Task Step 2: "Vascular pedicle" starts with the retraction of the vascular pedicle and ends with the complete dissection of the vein and artery, focusing on the assessment of appropriate level of section of the vascular pedicle and avoiding blind application of clips/stapler. Task Step 3: "Mobilization" starts with the separation of tissue planes after dissecting the vascular pedicle. It ends when the segment of large bowel is fully mobilized and ready to be resected, with the procedure scored against the adequacy of tissue planes maintained and length of mobilized bowel. Task Step 4: "Resection/anastomosis" starts with the preparation

Table 1 Data extracted from the included videos

Video characteristics	Date uploaded Country Total number of views and 30-day views Video length, full length or edited Conference, surgical society or live surgery video Peer review prior to publication
Image quality	High-definition Amount of time video affected by poor quality image
Supplementary educational content	Presence of audio or written commentary Use of diagrams and screenshots Procedure divided in steps Formal case presentation Preoperative imaging
Patient details	Age Sex BMI Indication for surgery Comorbidities, ASA score Previous surgery
Surgical details	Number of steps of the procedure demonstrated according to the LCAT* Position of the patient Position of the surgeon Number and position of the ports Site of specimen extraction Open part of the procedure demonstrated
Outcomes	Total operating time Intraoperative complications Estimated blood loss 30-day morbidity Length of hospital stay Pathologic staging and number of retrieved lymph nodes in case of malignancy

BMI body mass index, *ASA* American Society of Anaesthesiologists classification, *LCAT* laparoscopic competency assessment tool

* Exposure, vascular pedicle, colonic mobilization, anastomosis

of the bowel for dissection (e.g., clearance of mesentery around terminal ileum) and ends with the complete dissection of bowel and the creation of the anastomosis.

In summary, the surgical performance in each operative video recording was assessed by two independent assessors using the competency assessment tool. The overall mean score for each case (2 assessors, 16 items) ranges from 1 to 4, and the pass mark was set at 2.7 as validated in a previous study [23]. This pass mark was the score above which expert assessors rated the operations as 'safe performance,' defined by receiver operating characteristic (ROC) curve analysis.

Statistical analysis

Categorical data are presented as frequency counts and associated percentages; comparisons were made by means of Pearson's χ^2 test. Continuous data are presented as medians and ranges and were compared by using the Wilcoxon rank-sum test. A p value equal to or less than 0.05 was considered to be statistically significant. Statistical analyses were performed using STATA 12 statistical software (STATA Corp, College Station, Texas, USA).

Results

Search results

Thirty-one relevant websites were identified and 222 videos were retrieved, in which 15 duplicates, 11 videos not demonstrating a surgical procedure and 1 video not available for free were excluded. After the exclusion of 3 SILS, 2 robotic, 2 open surgery, 2 hand-assisted surgery, 2 videos only demonstrating the anastomosis, 1 combined surgical procedure, and 1 non-functioning link, 182 surgical videos were finally included. The Kappa statistic showed a high ($K=0.96$) agreement between reviewers on videos' selection.

Video characteristics

Thirty-seven videos (20.3%) were available in high-definition, while 41 (22.5%) demonstrated poor video quality which affected a clear vision for more than 50% of the video length. A vast majority of the videos were edited or truncated, in fact only 14 (7.6%) of the procedures demonstrated were recorded in full length. Six videos (3%) were presented at surgical meetings and 36 (19.7%) were presented by surgical societies, while 15 (8.2%) were recorded during a live-surgery session. Median video length was 9.27 min (range 1.05–155). One hundred and seventy-three videos (95%) detailed the year of publication: this demonstrated a significant increase in the number of videos published per year from 2009 onwards (Fig. 1). A video

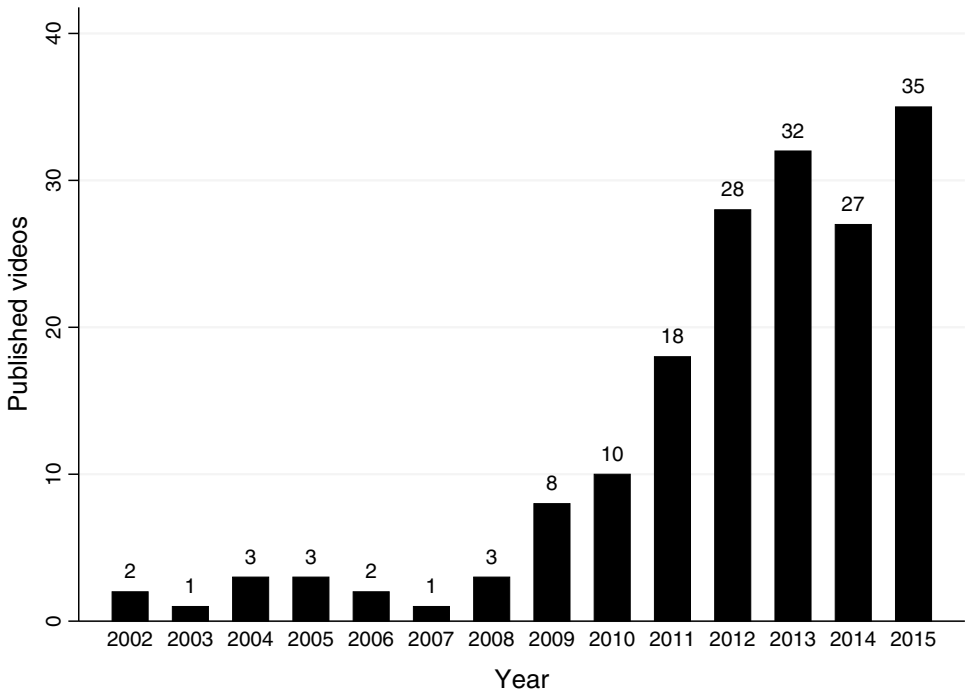

Fig. 1 Number of included videos per year

commentary was present in 107 cases (58%), 88.7% of commentaries were in English.

Patient characteristics

The characteristics of the patient were rarely presented. Forty-five (24.7%) videos detailed age which was 62 years (22–91), and 54 (29.6%) detailed sex, which was female in 61%. Only 14 videos (7.6%) reported BMI which was 23.5 (20–38) and only 4 videos (2.1%) detailed the American Society of Anesthesiologists (ASA) score.

Indication for surgery was reported in 103 videos (56.5%): this was cancer in 77.7%, IBD in 9.7%, with a mix of other indications making the remaining 12.6%.

Only 15 videos (8.2%) indicated if the patient had undergone previous abdominal surgery: this was none in 8 cases, 1 in 6 and multiple surgeries in 1.

Characteristics of the surgical procedures demonstrated

Exposure was shown in 41 (22.5%) videos and this was scored as safe in 87.2% of the cases according to the LCAT form.

The approach to the vascular pedicle was the most commonly demonstrated part of the procedure and was shown in 163 videos (89.5%), but this was considered safe in only 66% of the cases.

Colonic mobilization was demonstrated in 145 videos (79.7%) and safe in 69.8%, while the anastomosis was presented in 100 videos (54.9%) and safe in 87.7%.

Patient position on the operating table was shown in 41 (22.5%) of the videos, while surgeon's position only in 31 (17%).

Ports position was demonstrated in 80 (43.9%) of the videos, while specimen extraction was detailed in 100 (54.9%).

Outcome of the procedure

Only 10 videos (5.4%) reported operating time which was 75.5 min (42–300). Surprisingly, only 6 videos (3.2%) reported 30-day morbidity, which was zero in all. None of the videos reported estimated blood loss. Length of hospital stay was reported in 23 videos (12.6%) and was 4.4 days (1–9). When indication for surgery was cancer, as in 80 cases (43.9%), the final histology was reported in 30 (37.5%) and number of retrieved lymph nodes specified in 14 cases (17.5%).

Peer-reviewed vs not peer-reviewed

Thirty-four out of 182 videos (18.6%) underwent a peer-review process prior to publication. Formal case presentation, the presence of audio narration, the use of diagrams and snapshots, demonstration of the anastomosis, and a step-by-step approach are all characteristics of peer-reviewed videos (Table 2). However, 30-day morbidity

Table 2 Comparison of peer-reviewed with not peer-reviewed laparoscopic right hemicolectomy videos

	Peer-reviewed ($n=34$)	Not peer-reviewed ($n=148$)	P value
Views per month	11.55 [1.1, 177.5][a]	34.65 [0.2, 979.6][a]	0.252
Video length	9.04 [1.33–37.40][a]	11.94 [1.05–155][a]	0.080
HD	5 (14.7%)	32 (21.6%)	0.366
Audio narration	33 (97%)	74 (50%)	0.001*
Diagrams	21 (61.7%)	38 (25.7%)	0.001*
Case presentation	21 (61.7%)	36 (24.3%)	0.001*
Patient position	22 (64.7%)	19 (12.8%)	0.001*
Surgeon position	19 (55.9%)	12 (8.1%)	0.001*
Ports position	29 (85.3%)	51 (34.4%)	0.001*
Open phase demonstrated	16 (47%)	62 (41.9%)	0.583
Step-by-step approach	29 (85.3%)	71 (48%)	0.001*
Morbidity[††]	2 (5.9%)	4 (2.7%)	0.349
LOS[a] (days)	4 [3–7][a]	4.5 [1–9][a]	0.76
Histology[†]	8 out of 21 (38.1%)	22 out of 59 (37.2%)	0.219

HD high-definition, *LOS* length of hospital stay

[a]Data are expressed as median (range)

*P value equal or less than 0.05 was considered to be statistically significant

[†]Histology details when indication for surgery was cancer

[††]Number of videos in whom details on 30-day morbidity were presented

and LOS are as rarely reported in peer-reviewed as in non peer-reviewed videos. In display of exposure, vascular dissection, and colonic mobilization are found to be evenly distributed amongst peer-reviewed and non peer-reviewed videos. Peer-reviewed videos did not demonstrate higher LCAT safety scores.

Despite their greater use of narration and educational annotation, peer-reviewed videos do not have increased numbers of views per month; however, videos in which the steps demonstrated are all safe (57.7%), according to the LCAT, are significantly more viewed than videos in which one or more steps are not safe (42.3%), with views per month of 46.1 (0.3–979) and 12.7 (0.2–803), respectively ($P = 0.005$).

The proportion of peer-reviewed videos has significantly decreased over the years; in fact, 17 out of 23 videos published before the year 2010 were peer-reviewed, while only 17 out of 150 videos published after 2010 were peer-reviewed (Fig. 2).

In the same time period, the number of videos which demonstrate parts of the procedure performed "not safely" according to the LCAT score has also increased (Fig. 3).

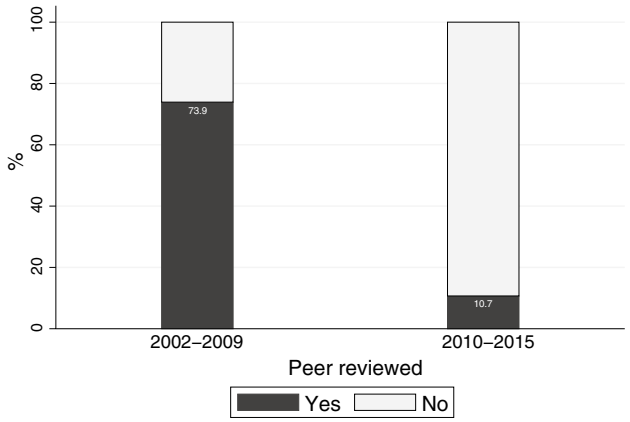

Fig. 2 Rate of peer-reviewed videos in 2002–2009, and 2010–2015

Live surgery videos

A step-by-step approach to the procedure was more common in live surgery videos as was formal case presentation. Operating ports, patient and surgeons' position were ordinarily demonstrated as was the open part of the procedure.

As with the peer-reviewed videos, the live surgery videos were more likely to show all parts of the surgical procedure than those not live recorded.

Discussion

This is the first study to assess the quality, safety, and educational value of laparoscopic colorectal videos published on the World Wide Web. The relevance of the topic is confirmed by the consistent increase we found in the number of laparoscopic colorectal videos published over the last 7 years. It is concerning that the rate of videos undergoing a formal peer-review process prior to publication has markedly decreased. This suggests that the publication of peer-reviewed videos for formal educational training has remained relatively stable, while the numbers of videos published by individuals have grown rapidly and continue to do so. This has the potential implication of reduced overall quality in terms of educational content presented to surgical trainees, although fortunately we saw no reduction in

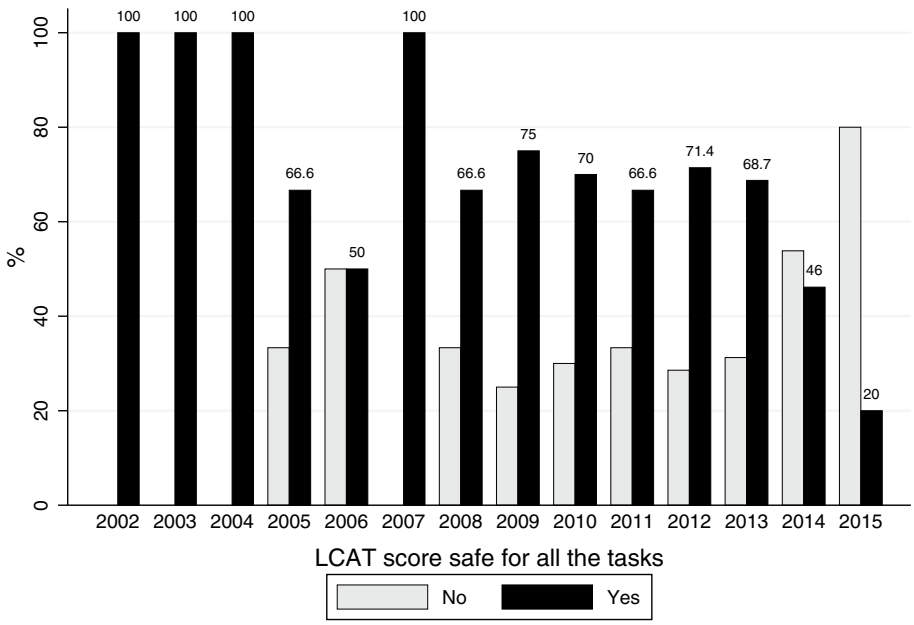

Fig. 3 Rate of videos in which all the tasks demonstrated were considered safe according to the LCAT scores

the safety of the procedures being demonstrated from these wider sources.

Our study is the first to acknowledge that there is a large resource available for distance learning in laparoscopic colorectal surgery, but significant variability exists among the videos with most of them lacking information on essential patient details such as age, comorbidities, and BMI, and procedure outcomes such as operating time, length of hospital stay, morbidity, and histology. The lack of information on port placement and surgeons and patient position also reflect how many videos are not suitable for educational purposes.

Peer-reviewed laparoscopic colorectal videos could represent a high-quality tool for distance learning, demonstrating a complex surgical procedure performed safely and effectively with a step-by-step approach, with supplementary material for educational purposes. However, these currently represent less than 20% of the resource available, and this has decreased since 2010.

As with peer-reviewed videos, we found that live-surgery broadcasts were more likely to show positioning and ports placement. They were also more likely to show all the steps of the procedure and these steps were more often performed safely. Live surgery broadcasts are therefore a promising training tool in terms of both safety of the procedure and educational content presented. They may be particularly useful to less experienced trainees who will

value careful narration and description of the systematic approach to the operation.

Courses including live surgical demonstrations are increasingly popular and considered to be useful not only for trainees but also for the independently practicing surgeons as an effective source of continuing medical education [24]. Nevertheless, despite their potential educational benefits, significant concerns about patient safety and clinical integrity remain [25]. Operating surgeons have in fact reported high levels of anxiety when performing live-demonstrations, which increased further when these took place at a foreign institution or in an unfamiliar environment [26, 27].

Performing complex laparoscopic procedures before a live audience creates a unique set of circumstances, which puts additional pressure on the surgeon and could expose the patient to increased risk. Patients should be made fully aware of the implications and potential risks associated with live surgery broadcasts [28] and surgeons should only perform standard procedures in which they are expert. To reduce anxiety and eliminate unfamiliarity with staff and equipment, it is advisable to perform complex surgical procedures only at the surgeon's home institution.

Our study has some limitations. Only websites mentioned in the first 100 results from each search were extracted. We know that the results with the most hits does not always mean the best quality [18]; however, 100 is a large number and therefore likely to be representative of the resources available. We faced the challenge of searching for scientific content on resources not specifically designed for this purpose, shifting from medical databases commonly used for systematic reviews, to websites designed for video sharing. Acknowledging this is as important as it is to note that the search strategy we used is more likely to reproduce how surgical trainees search for video educational material, which is the main focus of our review, as demonstrated by the additional trainees' survey we performed to minimize the risk of missing data.

We also found that those videos that were peer-reviewed or "safe" (according to LCAT) had more views than unreviewed and "not-safe" videos and therefore would be listed higher up in the search results.

The LCAT scoring system has been validated to assess the safety and quality of whole laparoscopic procedures, including video-recorded [22, 23]. A majority of the videos reviewed were edited and did not always include all parts of the procedure. However, in terms of assessing the procedure presented in the video clips available, we feel LCAT is the most useful objective tool available at this time.

As we have shown, there is a huge resource of laparoscopic videos available on the internet. Some sources such as WebSurg have been specifically designed for education; however this is not true of all sources. It is unfair to assume that all the laparoscopic colorectal videos available on the World Wide Web have been posted with the intention of being an educational resource and therefore perhaps some should not be assessed in this way. Conversely, videos posted on renowned educational resources are likely to be highly edited hindering the use of a safety assessment tool.

There is currently no standard accreditation or regulation for medical videos as training resources. Some of the resources reviewed (WebSurg and ORLive) have signed up to the HONCode [29] a code of conduct for medical and health websites. However, this applies to all online content, is not specific for audiovisual material and does not exclude resources with commercial funding. WebSurg also self-regulates its content with a rigorous peer review process and is affiliated with IRCAD-EITS (Research Institute against Digestive Cancer—European Institute of Telesurgery, University of Strasbourg) world renowned center for minimally invasive surgery training [19].

Our study demonstrates that there is a huge resource of potentially educational material available online for free; however, this is currently not regulated. These findings highlight the need for guidelines for online published laparoscopic videos to enable trainees to identify those resources most useful in a jungle of choices [18, 21]. The authors recommend attention to both selection of safely performed procedures and the educational content

provided. Demonstration of theatre set-up, including panoramic views of the operating room showing the position of the patient, surgeon and assistants, is mandatory as English language commentary and case information, including patient's details, postoperative follow-up and histopathological assessment. The use of snapshots and diagrams facilitates the recognition of anatomy and should be considered as the division of the procedure in different steps. Recognized surgical colleges, associations and societies could play a role in regulating this by recommending trusted resources to their trainee bodies.

In this review, we have not explored what trainees or trainers feel are the most useful features of laparoscopic videos for training and maintaining skills. This could be valuable and a Delphi study could be undertaken with surgical trainees and trainers to establish consensus. This could lead to the development of a checklist or guideline to facilitate trainees in selecting the best videos for their needs and to aid publishers of videos to include the most educational information possible.

Conclusion

Laparoscopic videos can be a useful adjunct to clinical and operative training. There is a large and increasing amount of material available for free on the internet, but this is currently unregulated. There is scope for an accreditation process or set of ideal standards to enable trainees to navigate these resources to select those videos with the best educational content.

Acknowledgements The authors declare no fundings were received for the preparation of the manuscript.

Compliance with ethical standards

Disclosures V. Celentano, M. Browning, C. Hitchins, M. C. Giglio, and M. G. Coleman have no conflicts of interest or financial ties to disclose.

References

1. Kerr B, O'Leary JP (1999) The training of the surgeon: Dr. Halsted's greatest legacy. Am Surg 65:1101–1102
2. Varley I, Keir J, Fagg P (2006) Changes in caseload and the potential impact on surgical training: a retrospective review of one hospital's experience. BMC Med Educ 6:6
3. Bell RH, Biester TW, Tabuenca A et al (2009) Operative experience of residents in US general surgery programs: a gap between expectation and experience. Ann Surg 249:719–724
4. Guillou PJ, Quirke P, Thorpe H et al (2005) Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. Lancet 365:1718–1726
5. Faiz O, Warusavitarne J, Bottle A et al (2009) Laparoscopically assisted vs. open elective colonic and rectal resection: a comparison of outcomes in English National Health Service Trusts between 1996 and 2006. Dis Colon Rectum 52:1695–1704
6. Miskovic D, Ni M, Wyles SM et al (2012) Learning curve and case selection in laparoscopic colorectal surgery: systematic review and international multicenter analysis of 4852 cases. Dis Colon Rectum 55:1300–1310
7. Kim J, Edwards E, Bowne W et al (2007) Medial-to-lateral laparoscopic colon resection: a view beyond the learning curve. Surg Endosc 21:1503–1507
8. Scott DJ, Young WN, Tesfay ST et al (2001) Laparoscopic skills training. Am J Surg 182:137–142
9. Stein S, Stulberg J, Champagne B (2012) Learning laparoscopic colectomy during colorectal residency: what does it take and how are we doing? Surg Endosc 26:488–492
10. Celentano V, Finch D, Forster L et al (2015) Safety of supervised trainee performed laparoscopic surgery for inflammatory bowel disease. Int J Colorectal Dis 30:639–644
11. Ozyurda F, Dökmeci F, Palaoğlu O et al (2002) The role of interactive training skills courses in medical education at the Ankara University School of Medicine. Teach Learn Med 14:189–193
12. Nageswari KS, Malhotra AS, Kapoor N et al (2004) Pedagogical effectiveness of innovative teaching methods initiated at the Department of Physiology, Government Medical College, Chandigarh. Adv Physiol Educ 28:51–58
13. McEwen A, Moorthy C, Quantock C et al (2007) The effect of videotaped preoperative information on parental anxiety during anesthesia induction for elective pediatric procedures. Paediatr Anaesth 17:534–539
14. Saab BR, Usta J, Major S et al (2009) Impact of a communication skills audiovisual package on medical students' knowledge. J Med Liban 57:226–230
15. Hall JC (2002) Imagery practice and the development of surgical skills. Am J Surg 184:465–470
16. Mukhopadhyay S, Kruger E, Tennant M (2014) YouTube: a new way of supplementing traditional methods in dental education. J Dent Educ 78:1568–1571
17. Fischer J, Geurts J, Valderrabano V et al (2013) Educational quality of YouTube videos on knee arthrocentesis. J Clin Rheumatol 19:373–376
18. Jaffar AA (2012) YouTube: an emerging tool in anatomy education. Anat Sci Educ 5:158–164
19. Dinscore A, Andres A (2010) Surgical videos online: A survey of prominent sources and future trends. Med Ref Serv Q 29:10–27
20. Singh AG, Singh S, Singh PP (2012) YouTube for information on rheumatoid arthritis–a wakeup call? J Rheumatol 39:899–903
21. Duncan I, Yarwood-Ross L, Haigh C (2013) YouTube as a source of clinical skills education. Nurse Educ Today 33:1576–1580
22. Mackenzie H, Ni M, Miskovic D et al (2015) Clinical validity of consultant technical skills assessment in the English National Training Programme for Laparoscopic Colorectal Surgery. Br J Surg 102(8):991–7
23. Miskovic D, Ni M, Wyles SM et al (2013) Is competency assessment at the specialist level achievable? A study for the national training programme in laparoscopic colorectal surgery in England. Ann Surg 257:476–482
24. Mullins JK, Borofsky MS, Allaf ME et al (2012) Live robotic surgery: are outcomes compromised? Urology 80:602–607
25. Kallmes DF, Cloft HJ, Molyneux A et al (2011) Live case demonstrations: patient safety, ethics, consent, and conflicts. Lancet 377:1539–1541
26. Khan SA, Chang RT, Ahmed K et al (2014) Live surgical education: a perspective from the surgeons who perform it. BJU Int. doi:10.1111/Bju.12283 **[1464–410X (Electronic), LID]**

27. Duty B, Okhunov Z, Friedlander J et al (2012) Live surgical demonstrations: an old, but increasingly controversial practice. Urology 79:e7–e11
28. Challacombe B, Weston R, Coughlin G et al (2010) Live surgical demonstrations in urology: valuable educational tool or putting patients at risk? BJU Int 106:1571–1574
29. Health on the net foundation. The HON Code of Conduct for medical and health Web sites (HONcode). Available at https://www.healthonnet.org/