Annals of Medicine and Surgery 26 (2018) 19–23

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Impact of medial-to-lateral vs lateral-to-medial approach on short-term and cancer-related outcomes in laparoscopic colorectal surgery: A retrospective cohort study

Anwar Hussain*, Fahad Mahmood, Andrew W. Torrance, Achilleas Tsiamis

Department of Surgery, University Hospital North Midlands, Royal Stoke University Hospital, Stoke-on-Trent, UK

ARTICLE INFO

Manuscript presented as oral presentation at British association of surgical oncology congress, Liverpool, UK. 6th November 2016.

Keywords:
Colorectal cancer
Method of surgery
Lateral mobilisation
Mesocolon
Medial mobilisation
survival

ABSTRACT

Background: Laparoscopic surgery is the favoured method of colorectal cancer resections. It is surgeon expertise and discretion to choose whether to mobilize colon lateral-to-medial or medial-to-lateral. We aim to identify the advantage of one approach over the other in short-term and cancerrelated outcomes.

Methods: A retrospective review of a prospectively maintained database of all laparoscopic colorectal resections with curative-intent, in a single unit, from March 2013 to October 2014. Data was collected on patient demographics, method of laparoscopic mobilisation, operating time, length-of-stay, post-operative complications, clearance of circumferential resection margins lymph node harvest and follow-up.

Results: 137 patients with comparable patient demographics had laparoscopic colorectal cancer resection. 76 (60.3%) male and 50 (39.7%) female patients. 58(46.0%) of resections were performed using medial-to-lateral approach, while 68(54.0%) lateral-to-medial. Lateral group had on average 14(0–38) lymph nodes with specimen compared to 17 (6–45) in medial group. There was a statistically significant difference in the major complication rate (Clavien-Dindo IV) between the groups with 1(1.7%) in the medial-to-lateral group compared to 7 (10.2%) in the lateral-to-medial group, (p .035). Patients in the medial-to-lateral group had median length-of-stay of 7 days (range 2–55) compared to 7 days (range 2–75) in the lateral-to-medial group. There was no statistically significant difference in survival between both groups up-to 1334 days p = .413.

Conclusion: Our study shows that mobilising the colon medially in laparoscopic colorectal cancer resection increases the lymph node harvest, gives comparable CRM clearance, similar length of hospital stay and complications. It makes no statistically significant difference in the overall patient survival.

1. Introduction

Colorectal cancer is the third most common malignancy worldwide accounting for 9% of all cancer incidence [1]. The laparoscopic approach for colorectal resections has gained increasing acceptance since first described in 1991 [2,3]. Compared to open surgery, laparoscopic colorectal surgery is associated with improved short term outcomes including faster recovery, reduced duration of post-operative ileus, lower wound infection rates, shorter hospital stay, reduced post-op pain and earlier tolerance of regular diet [3–10]. Furthermore, there is no reported difference in overall survival, oncological clearance, recurrence rates, complication rates, or re-operation rate between the two approaches [4,6,8,11]. The above studies demonstrate the feasibility, safety and short-term benefits of the laparoscopic approach.

Despite the advantages, laparoscopic surgery is technically challenging, with a steep learning curve [12] and associated with increased operative time compared to open surgery [8]. This involves laparoscopic mobilization of the colon, division of the inferior mesenteric vessels, exteriorization and resection of bowel and fashioning an anastamosis [13]. Thus, there is an ongoing need to standardize laparoscopic colorectal resections for improved outcomes.

Laparoscopic colorectal mobilization can follow one of two approaches. The traditional lateral-to-medial (L-M) sequence of division used in open procedures starts with division of the lateral peritoneal attachments followed by exploration of the medial mesentery and division of the blood vessels [14,15]. Subsequently a medial-to-lateral (M-L) approach was developed by Milsom and colleagues with the inferior mesenteric vessels initially identified and divided proximally followed by division of the lateral peritoneal attachments [16,17]. The European Association of Endoscopic Surgeons (EAES) consensus statement in 2004 recommended a medial-to-lateral approach for mesocolonic dissection [18]. However, few studies have subsequently been

* Corresponding author. Department of Surgery, University Hospital North Midlands, Newcastle Road, Stoke-on-Trent, ST4 6QG, UK.
E-mail address: anwar.hussain@doctors.org.uk (A. Hussain).

https://doi.org/10.1016/j.amsu.2017.12.011
Received 29 September 2017; Received in revised form 5 December 2017; Accepted 21 December 2017

published evaluating the comparative efficacy between the two approaches and contribute to the evidence base for this approach.

In the present study, we aim to compare the medial-to-lateral versus lateral-to-medial approach during laparoscopic mesocolonic dissection for colorectal cancer in terms of overall survival, operating time, circumferential resection margin (CRM) clearance, lymph node harvest, complications and length of post-operative hospital stay.

2. Materials and methods

A retrospective cohort review of a prospectively maintained database was performed (Research Registry UIN: researchregistry3351). All operations were performed at a single, high-volume teaching hospital from March 2013 to October 2014. All patients were discussed perioperatively at a specialist colorectal cancer multidisciplinary meeting and proven to have colorectal cancer. A consultant pathologist reviewed all histology reports.

All the operations were performed by consultant colorectal surgeon with appropriate laparoscopic training and experience. Each consultant performs at least 20 laparoscopic colorectal cancer resections per year.

All patients undergoing laparoscopic resections for colorectal cancer with curative intent were included. Data was collected on patient demographics, operating surgeon, method of laparoscopic mobilization, intent of procedure, site of tumour, stage of tumour, operating time, length-of-stay, post-operative complications, clearance of circumferential resection margins (CRM) and lymph node harvest.

2.1. Inclusion criteria

Patients aged 18 or above with confirmed colorectal cancer diagnosis by histology that subsequently underwent elective or emergency laparoscopic surgery with resections performed with curative intent.

2.2. Exclusion criteria

Those patients aged less than 18 undergoing non-cancer resections or open operations or completion surgery (as part of another operation) as well as resections performed with palliative intent were all excluded from the study.

2.3. Surgical technique

All patients underwent laparoscopic resection of the colorectal cancer and the colon was initially mobilised either laterally or medially depending upon surgeons' choice and expertise. All the patients had stapled extra-corporeal ileo-colic, colo-colic or colorectal anastomosis. All the patients received standard comparable postoperative care.

2.4. Data analysis

Data was analysed using SPSS 24.0 (IBM SPSS Inc. Armonk, NY, USA). Comparisons between groups were made using chi-square test or fisher's exact test as appropriate. Results were extrapolated in box and whisker plot. P-value < .05 was considered significant. Kaplan-Meier survival analysis and Cox-regression to determine hazard ratios for the different co-variates between the 2 groups were determined using SPSS.

This study has been reported in compliance with strengthening the reporting of cohort studies in surgery (STROCSS) criteria [19].

3. Results

205 patients with colorectal cancer underwent resectional surgery over the study period of which 137 (66.8%) patients had laparoscopic surgery. 11 patients were excluded from the final data along with 10 patients who had a palliative operation and 1 patient who underwent a completion proctectomy. A total of 126 patients were finally included in the analysis.

Table 1
Patient and procedure characteristics.

	Total	Medial	Lateral	p
Total	126	58 (46.0%)	68 (54.0%)	n/s
Male	76 (60.3%)	35 (46.1%)	41 (53.9%)	n/s
Female	50 (39.7)	23 (46.0%)	27 (54.0%)	n/s
Elective	120 (95.2%)	58 (48.3%)	62 (51.7%)	n/s
Emergency	6 (04.8%)	0	6	

Table 2
Procedure details.

Procedure	Total	Medial	Lateral
Anterior Resection	54	24 (44.4%)	30 (55.5%)
Hartmann's procedure	9	4	5
Right Hemi-colectomy	33	15	18
Abdomino-perineal resection	16	12	4
Left Hemi-colectomy	12	2	10
Transverse colectomy	1	0	1
Subtotal colectomy	1	1	0

Overall, 76 (60.3%) were male with median age of 65 years (Range 28–95 years) (Tables 1 and 2). 120 (95.2%) operations were performed as elective procedures. 58 (46.0%) patients had surgery with medial-to-lateral surgical technique. 68 (54.0%) patients found in the lateral-to-medial group. 90 (72.6%) patients had left sided resections. 33 (26.6%) patients underwent right sided resections.

3.1. Operating times

Median operating time taken during left sided resections (91) in the medial-to-lateral group was 268 (140–536) minutes while lateral-to-medial group was 228 (122–368) minutes (Table 3, Fig. 1). Right-sided resections took 186 (114–317) minutes in the medial-to-lateral group compared to 176 (76–297) minutes in the lateral-to-medial, (p = .59). Anterior Resections (54) were performed in a median time of 288 (140–536) minutes in the medial-to-lateral group compared to 242 (134–368) minutes in the lateral-to-medial group, (p 0.051).

3.2. Circumferential resection margin (CRM) positivity

Overall 11 (8.7%) patients had positive CRM at postoperative histological assessment. Of these, 6 (4.7%) were in the lateral-to-medial group and 5 (3.9%) in the medial-to-lateral group. Table 4 details the procedures with positive CRM. When CRM is analysed according to tumour T stage, 6 (54.5%) specimens with positive CRM were T3, 4 (36.4%) were T4 and 1 (9.0%) was T1 (iatrogenic tumour perforation when stapler went through the tumour). No significant differences were

Table 3
Operating times.

Procedure	M-L Op time (mins)	L-M Op time (mins)	Z Value	p
Anterior Resection	288 (140–536)	242 (134–368)	1.9218	.05
Hartmann's procedure	222 (196–248)	193 (155–250)	Too small sample	
Right Hemi-colectomy	186 (114–317)	176 (76–297)	0.5298	.59
Abdomino-perineal resection	318 (248–512)	293 (243–354)	Sample too small	
Left Hemi-colectomy	244 (212–266)	186 (122–298)	Sample too small	
Transverse colectomy	n/a	202		
Subtotal colectomy	244	n/a		

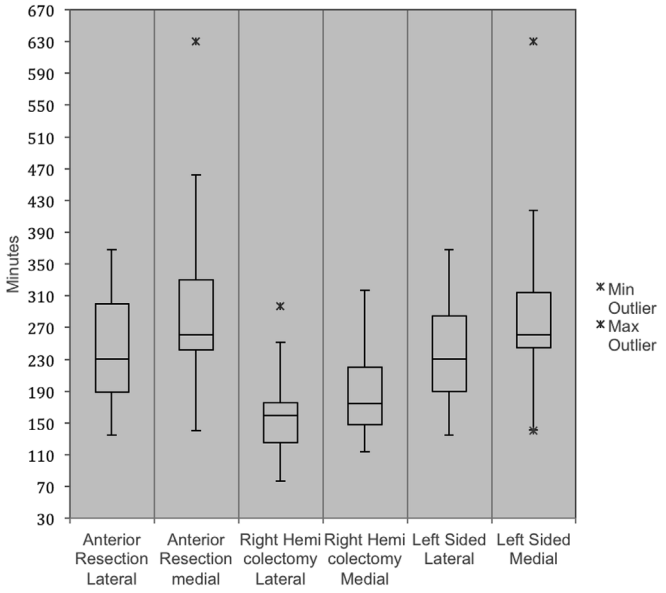

Fig. 1. Box and whisker plot of operating times.

Table 4
CRM status.

	Total	M-L	L-M	p
+ve CRM	11 (8.7%)	5 (3.9%)	6 (4.7%)	n/s
Abdomino-perineal resection	2	1	1	n/s
Anterior resection	7	3	4	n/s
Right hemi colectomy	2	1	1	n/s

identified between the groups with respect to gender, age or surgical approach.

3.3. Lymph node harvest

The median number of lymph nodes dissected and found in the pathological specimens of the medial-to-lateral group were 17 (6–45) compared to 14 (0–38) in the lateral-to-medial group. No statistically significant difference was found between the 2 groups.

3.4. Complications

Individual complication rates are summarized in Table 5. Wound infection occurred in 5 (8.1%) patients in the medial-to-lateral group compared to 3 (4.1%) in the lateral-to-medial group. 1 (1.6%) patient in the medial-to-lateral while 2 (2.7%) patients in the lateral-to-medial group had an anastomotic leak.

2 (3.2%) patients in medial-to-lateral group required a reoperation for complications while 4 (5.5%) patients had reoperations in the lateral-to-medial group. No statistically significant differences were detected regarding individual complications apart from ileus, which occurred in 3 (4.8%) patients in the medial-to-lateral group compared to 12 (16.4%) patients in the lateral-to-medial group, (p 0.022) (Table 5). 1 patient from each group died within 30 days of operation.

Table 5
Complications.

	M-L	L-M	p
Wound complications	5 (8.1%)	3 (4.1%)	n/s
Re-operation	2 (3.2%)	4 (5.5%)	n/s
Anastomotic leak	1 (1.6%)	2 (2.7%)	1
Ileus	3 (4.8%)	12 (16.4%)	.022
Post-operative death	1 (1.6%)	1	n/s
Length of stay (Median days (range))	7 (2–55)	7 (2–75)	n/s

Table 6
Clavien-Dindo grading of complications.

Grade	Medial	Lateral	p
I	6 (10.3%)	8 (11.7%)	.8
II	11 (18.9%)	2 (2.9%)	.004
III	4 (6.9%)	6 (8.8%)	.687
IV	1 (1.7%)	7 (10.2%)	.035
V	1 (1.7%)	1 (1.4%)	.910

We classified the postoperative complications according to the Clavien-Dindo classification (Table 6). There was a statistically significant difference in the major complication rate (Clavien-Dindo IV) between the groups with 1 (1.7%) in the medial-to-lateral group compared to 7 (10.2%) in the lateral-to-medial group, (p 0.035). Minor complications (Clavien-Dindo II) were however seen more frequently in the medial-to-lateral group with 11 (18.9%) patients affected compared to 2 (2.9%), (p 0.004).

3.5. Length of postoperative hospital stay

Patients in both groups had similar length-of-stay in hospital post operatively. Patients in the medial-to-lateral group had a median length-of-stay of 7 days (range 2–55) compared to 7 days (range 2–75) in the lateral-to-medial group.

3.6. Survival analysis

Data for survival between the 2 groups was analysed up to 1334 days post-operatively for the latest follow-up. In the lateral-to-medial group 18 patients died out of 68 operated on whereas in the medial-to-lateral group there were 11 deaths out of 58 during this time-period. Mean survival in the lateral-to-medial group was 1118 days (95% CI 1022–1213) and in the medial-to-lateral group was 1137 days (95% CI 1049–1225). Overall median survival was 1334 days. The Log Rank test (Kaplan-Meier) was run to determine if there was a difference in survival distribution between lateral-to-medial vs medial-to-lateral approach. The survival distributions for the 2 different approaches was not statistically significantly different, ($\chi^2 = 0.670$, $p = .413$). Overall survival was thus similar between both lateral-to-medial and medial-to lateral groups (Table 7, Figs. 2–3).

Cox regression analysis was used to determine co-variates that may impact on survival in our cohort of patients (Table 8). Age, gender, presence of complications and the medial-to-lateral vs lateral-to-medial approach were used to determine the hazard ratio for survival. None of the above co-variates were significantly associated with an increased survival hazard. Thus, survival is not significantly different between groups.

Table 7
Survival analysis.

	Total	L-M	M-L	Significance
Total	126	68	58	
Event s	29	18	11	
Median follow-up	970 (0–1334)	950 (0–1334)	985 (30–1297)	
Mean survival	1140 days (95% CI 1072–1207)	1118 days (95% CI 1022–1213)	1137 days (95% CI 1049–1225)	0.413

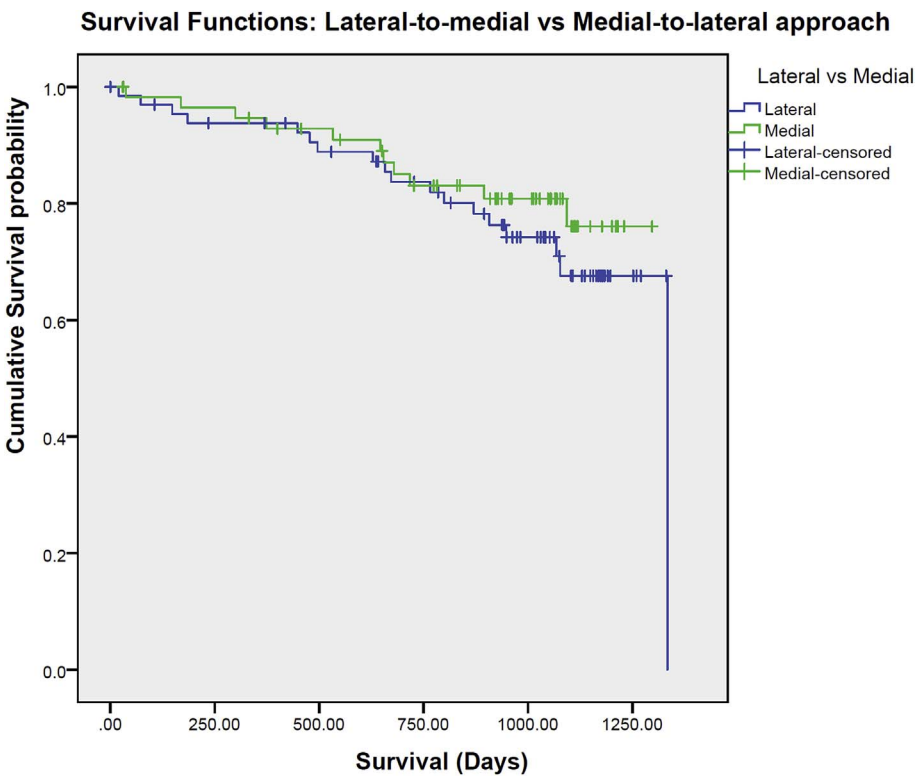

Fig. 2. Kaplan-Meier curve for survival.

Table 8
Cox Regression analysis comparing factors that may impact on the survival of patients undergoing laparoscopic colorectal cancer resections.

Group	Hazard ratio	95%CI lower	95%CI Upper	Sig. p-value
Age	1.012	0.974	1.052	0.528
Gender	0.568	0.245	1.317	0.187
Lateral vs Medial	1.399	0.655	2.989	0.386
Complication	0.762	0.352	1.649	0.491

4. Discussion

Our study examined several parameters that could provide evidence justifying lateral-to-medial or medial-to-lateral approach in laparoscopic colorectal cancer resections. Our data demonstrates increased complication rates in the lateral-to-medial group with increased rate of post-operative ileus and major complications as per the Clavien-Dindo classification. However, no significant difference was demonstrated in rates of wound infection, anastomotic leak, re-operation rate or 30-day mortality between the two groups. Furthermore, survival was equivalent in both approaches when assessed over a longer time period up to 1334 days. When analysing specific factors that may have impacted survival in our cohort of patients, no appreciable difference was found between the type of procedure, age, gender or rate of complications although the need for long-term follow-up of these patients is acknowledged. In addition, no time difference between either approach was demonstrated although shorter time duration for the lateral-to-medial approach in anterior and right-sided resection approaches significance. Furthermore, no statistically significant difference was found in CRM positivity or lymph node harvest when comparing both approaches.

The medial-to-lateral approach has become increasingly popular in recent years with several recent supportive studies. A meta-analysis by Ding and colleagues reported a number of advantages for this approach having analysed 5 cohort studies including 2 randomized control trials and 3 retrospective studies incorporating 881 patients [20–24]. They reported a reduced conversion rate for medial-to-lateral group (although this was comparable in the pooled data across both RCTs), as well as significantly shorter operative time and reduced blood loss although this approach led to fewer harvested lymph nodes. Moreover, rates for post-operative complications, wound infection, anastomotic leak, recurrence, and mortality as well as length of hospitalization were not significantly different between the two groups. The reasons for a higher conversion rate include adhesions, which may be greater on the lateral side and thus increase risk of damaging surrounding structures as well as higher rate of injury to retroperitoneal structures including blood vessels, duodenum and the ureter. Medial-to-lateral mobilization may allow identification and protection of these important structures and by early identification of the mesocolonic-retroperitoneal plane, facilitate swift dissection with minimized blood loss. Additional perceived disadvantages of the lateral-to-medial approach include increased redundancy of the colon, which can make the subsequent manipulation of the colon more difficult. The lateral attachment facilitates medial mesenteric dissection by helping to provide counter-traction. Moreover, earlier division of the vascular pedicles may reduce subsequent bleeding and earlier identification of the ureter and gonadal vessels may prevent damage of these structures. Our study however does not demonstrate any significant time difference between the 2 approaches. This could be due to individual surgeons preferring a given technique and demonstrating better temporal efficiency.

Our study contributes to the growing body of evidence that supports the medial-to-lateral approach in laparoscopic colorectal resections. Although we did not demonstrate increased efficiency in the technique as others have shown, we did show reduced post-operative complications including post-op ileus similar to previous studies, which may help reduce post-op hospital, stay [21]. However, this study is a retrospective study and apart from the intended comparison of medial-to-lateral vs lateral-to-medial approaches several other factors could have affected our results such as the individual surgeons experience and preferences as well as patient specific factors. Although during the time-period of our study (2013–2014) we do not believe that advances in surgical technology would have impacted our results.

In conclusion, further larger prospective studies are required to demonstrate the efficiency and safety of the medial-to-lateral approach for laparoscopic colorectal cancer resections, which may help to standardize this technique for future practice.

Ethical approval

Information board Judgement sought. NOC issued from them.

Funding

Nil.

Author contribution

AHê→ Design, data collection, writing.
FMê→ writing, analysing, corrections.
ATê→ Design, summarising.
A Tsiamisê→ Supervision.

Conflicts of interest

Nil.

Trial registry number – ISRCTN

NA.

Guarantor

Anwar Hussain.

Research registration unique identifying number (UIN)

NA.

References

[1] F.A. Haggar, R.P. Boushey, Colorectal cancer epidemiology: incidence, mortality, survival, and risk factors, Clin. Colon Rectal Surg. 22 (4) (2009) 191–197.
[2] M. Jacobs, J.C. Verdeja, H.S. Goldstein, Minimally invasive colon resection (laparoscopic colectomy), Surg. Laparosc. Endosc. 1 (3) (1991) 144–150.
[3] A. Lacy, Colon cancer: laparoscopic resection, Ann. Oncol. 16 (Suppl 2) (2005) ii88–ii92.
[4] N.S. Abraham, J.M. Young, M.J. Solomon, Meta-analysis of short-term outcomes after laparoscopic resection for colorectal cancer, Br. J. Surg. 91 (9) (2004) 1111–1124.
[5] O. Aziz, et al., Laparoscopic versus open surgery for rectal cancer: a meta-analysis, Ann. Surg Oncol. 13 (3) (2006) 413–424.
[6] Clinical_Outcomes_of_Surgical_Therapy_Study_Group, A comparison of laparoscopically assisted and open colectomy for colon cancer, N. Engl. J. Med. 350 (20) (2004) 2050–2059.
[7] A.M. Lacy, et al., Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial, Lancet 359 (9325) (2002) 2224–2229.
[8] J.J. Tjandra, M.K. Chan, Systematic review on the short-term outcome of laparoscopic resection for colon and rectosigmoid cancer, Colorectal Dis. 8 (5) (2006) 375–388.
[9] B. Di, et al., Laparoscopic versus open surgery for colon cancer: a meta-analysis of 5-year follow-up outcomes, Surg. Oncl. 22 (3) (2013) e39–e43.
[10] A. Biondi, et al., Laparoscopic vs. open approach for colorectal cancer: evolution over time of minimal invasive surgery, BMC Surg. 13 (Suppl 2) (2013) S12.
[11] J. Fleshman, et al., Effect of laparoscopic-assisted resection vs open resection of stage II or III rectal cancer on pathologic outcomes: the ACOSOG Z6051 randomized clinical trial, J. Am. Med. Assoc. 314 (13) (2015) 1346–1355.
[12] F.R. Jamali, et al., Evaluating the degree of difficulty of laparoscopic colorectal surgery, Arch. Surg. 143 (8) (2008) 762–767 discussion 768.
[13] P.P. Tekkis, et al., Evaluation of the learning curve in laparoscopic colorectal surgery: comparison of right-sided and left-sided resections, Ann. Surg. 242 (1) (2005) 83–91.
[14] G.C. Hoffman, et al., Laparoscopic-assisted colectomy. Initial experience, Ann. Surg. 219 (6) (1994) 732–740 discussion 740-3.
[15] T.D. Elftmann, et al., Laparoscopic-assisted segmental colectomy: surgical techniques, Mayo Clin. Proc. 69 (9) (1994) 825–833.
[16] J.W. Milsom, et al., Laparoscopic oncologic proctosigmoidectomy with low colorectal anastomosis in a cadaver model, Surg. Endosc. 8 (9) (1994) 1117–1123.
[17] J.W. Milsom, et al., A prospective, randomized trial comparing laparoscopic versus conventional techniques in colorectal cancer surgery: a preliminary report, J. Am. Coll. Surg. 187 (1) (1998) 46–54 discussion 54-5.
[18] R. Veldkamp, et al., Laparoscopic resection of colon cancer: consensus of the European association of endoscopic surgery (EAES), Surg. Endosc. 18 (8) (2004) 1163–1185.
[19] R.A. Agha, M.R. Borrelli, M. Vella-Baldacchino, R. Thavayogan, D.P. Orgillfor the STROCSS Group, The STROCSS statement: strengthening the reporting of cohort studies in surgery, Int. J. Surg. 46 (2017) 198–202.
[20] J. Ding, et al., Medial versus lateral approach in laparoscopic colorectal resection: a systematic review and meta-analysis, World J. Surg. 37 (4) (2013) 863–872.
[21] J.T. Poon, et al., Impact of the standardized medial-to-lateral approach on outcome of laparoscopic colorectal resection, World J. Surg. 33 (10) (2009) 2177–2182.
[22] J.T. Liang, H.S. Lai, P.H. Lee, Laparoscopic medial-to-lateral approach for the curative resection of right-sided colon cancer, Ann. Surg Oncol. 14 (6) (2007) 1878–1879.
[23] W. Day, P.Y. Lau, Impact of the standardized medial-to-lateral approach on outcome of laparoscopic colorectal resection. is it a fair comparison? World J. Surg. 34 (5) (2010) 1146–1147 author reply 1148-9.
[24] N.A. Rotholtz, et al., Laparoscopic colectomy: medial versus lateral approach, Surg. Laparosc. Endosc. Percutaneous Tech. 19 (1) (2009) 43–47.