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Case Series

Short–term outcomes of laparoscopic colorectal cancer surgery in elderly patients. -Is it really safe in elderly patients with severe comorbidities?-

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ABSTRACT

Introduction: We aimed to assess the safety and validity of laparoscopic colorectal surgery (LCS) in elderly patients focusing on severe postoperative complications.In addition, we compared multiple preoperative risk scoring tools to identify the optimal tool forpredicting postoperative complications.
Methods: Medical records of 493 patients who underwent LCS or open colorectal surgery (OCS) were retrospectively reviewed and they were divided into four groups based on their age and procedure: group E/LCS (age $\geq$ 80 years and LCS), group Y/LCS (age < 80 years and LCS), group E/OCS (age $\geq$ 80 years and OCS), and group Y/OCS (age < 80 years and OCS). Preoperative characteristics and postoperative outcomes were analyzed. Furthermore, patients were divided into two groups based on the incidence of postoperative complication. Physiological score and Operative severity score from POSSUM, Physiological score and Operative severity score from CR-POSSUM, Preoperative risk score, Surgical stress score, and comprehensive risk score from E-PASS, SAS, and PNI were compared.
Results: The incidence of postoperative complications was significantly lower in group E/LCS than in groups E/OCS and Y/OCS. Respiratory and cardiovascular complications were not observed in E/LCS, even though patients had severe cardiovascular comorbidities. Regarding the comparison of risk scoring tools, all of the risk scoring tools did not differ between two groups except SSS.
Conclusion: There is a possibility that the severity of heart failure does not affect postoperative complications in LCS. Regarding risk scoring tools, there was no suitable preoperative risk scoring tool which gives an advice on if we can perform LCS safely.

1. Introduction

Colorectal cancer is one of the common gastrointestinal cancers in many developed countries, and its incidence is expected to increase by 60% by 2030 [1]. In these countries, as the aging population increases, the number of elderly patients who need surgical intervention also increases. Elderly patients usually exhibit more comorbidities than younger patients; therefore, they are considered as high-risk patients for colorectal surgery [2]. Some studies have reported the increase of postoperative morbidities and mortalities in elderly patients [3–5].

Compared with open colorectal surgery (OCS), laparoscopic colorectal surgery (LCS) has exhibited advantages such as less postoperative pain, shorter hospital stay, and lower incidence of postoperative complications [6,7]. Recently, several randomized trials have demonstrated that LCS provides equivalent oncologic results compared with OCS [8–11]. Therefore, LCS appears to be a suitable treatment for elderly patients. However, during laparoscopic surgery, pneumoperitoneum and changing position affect hemodynamics and the respiratory system, particularly in elderly patients [12,13]. Because elderly patients exhibit multiple comorbidities, such as cardiovascular disorders, pulmonary diseases, and cerebrovascular disorders, we should carefully consider the indication of LCS in these patients.

Previous comparative studies between LCS and OCS have reported the safety of LCS for elderly patients [14–20]. However, the definition of “elderly patients” is different among these studies. Furthermore, studies particularly on octogenarians with colorectal cancer are rare [14,15,21]. Therefore, in this study, we aimed to assess the safety and validity of LCS for patients aged >80 years.

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2. Methods

Medical records of 493 consecutive patients who underwent LCS or OCS for colorectal cancer between 2010 and 2016 were retrospectively reviewed (Fig. 1). A total of 48 patients who met one of the following conditions were excluded from our study: double primary colorectal cancer, colorectal cancer with other gastrointestinal cancer, emergency surgery for intestinal obstruction caused by colorectal cancer, total pelvic exenteration, familial adenomatous polyposis, and appendix cancer. The study protocol was approved and reviewed by the Ethics Committee of South Miyagi Medical Center. Informed consent was waived by the Ethics Committee of the South Miyagi Medical Center.

All patients underwent standard radical surgery based on the Japanese Classification of Colorectal Carcinoma (8th edition) [22], except those who underwent palliative partial resection. Intestinal excision with lymph node dissection, which separated the feeding vessel from the tumor, was performed. All patients diagnosed with extramural invasion by computed tomography underwent OCS. Conversely, in the remaining patients, the surgical approach (LCS or OCS) was decided by the surgeon and patient after the benefits and risks of the approaches were explained.

Patients who underwent conversion to OCS from LCS were included in the OCS group; the conversion was defined as an unplanned incision >8 cm during laparoscopic surgery. At least one board-certified surgeon of the Japan Surgical Society participated in all surgeries.

In this study, patients aged ≥80 years and <80 years were defined as elderly and younger patients, respectively. The remaining 445 patients were divided into four groups based on their age and procedure undergone: group E/LCS (age ≥80 years and LCS), group Y/LCS (age <80 years and LCS), group E/OCS (age ≥80 years and OCS), and group Y/OCS (age <80 years and OCS). Patients in group E/LCS were compared with those in groups Y/LCS, E/OCS, and Y/OCS. Preoperative characteristics and postoperative outcomes were analyzed.

Patients' characteristics, including age, sex, body mass index (BMI), performance status (Eastern Cooperative Oncology Group), American Society of Anesthesiologists Physical Status (ASA-PS) classification, preoperative comorbidity, and operative procedure, were analyzed. The following perioperative outcomes were also analyzed: operative procedures, operative time, blood loss, number of harvested lymph nodes, curative surgery, pathological stage (Japanese Classification of Colorectal Carcinoma), postoperative complications, and length of postoperative hospital stay.

Data were expressed as mean ± standard error of the mean (SEM). Categorical variables were analyzed using the chi-square test, whereas continuous ones were analyzed using one-way analysis of variance (ANOVA) followed by Dunnett's test. Statistical significance was defined as $P < 0.05$. Statistical analysis was performed using JMP Pro 11 software (SAS Institute, Cary, NC, U.S.).

3. Results

Of the 445 patients included in this study, 33, 140, 89, and 183 were classified into groups E/LCS, Y/LCS, E/OCS, and Y/OCS, respectively. Eight patients underwent conversion from LCS to OCS. The reasons for conversion were extramural invasion in four patients, severe adhesion due to previous surgery in three patients, and refractory bleeding in one patient. The number of males in groups Y/LCS and Y/OCS was significantly higher than that in group E/LCS. The performance status in group E/LCS was significantly worse than that in groups Y/LCS and Y/OCS. No patient with a performance status of four underwent LCS. A significant difference was not observed with respect to BMI, ASA-PS, and tumor location (Table 1). For all comorbidities, patients in group Y/OCS exhibited significantly low comorbidities compared with those in group E/LCS (Table 2). No significant differences were found between group E/LCS and the other groups with regard to cardiovascular comorbidity. However, the number of patients over stage C [American Heart Association/American College of Cardiology (AHA/ACC) stage] in group E/LCS was greater than that in groups Y/LCS and Y/OCS. Respiratory comorbidity was similar between group E/LCS and the other groups. Although the number of patients with a forced expiratory volume (FEV) in 1 s (%) of <50% and/or vital capacity (VC) (%) of <60% did not differ between group E/LCS and the other groups, these patients were not present in group E/LCS. No difference was observed for other comorbidities, with the exception of hypertension. The number of patients undergoing anticoagulant therapy did not differ between group E/LCS and the other groups. Patients with chronic steroid was not present in group E/LCS. In terms of operative details, right colectomy/ileocecal resection was performed more frequently in group E/LCS than in group Y/LCS. Other surgical procedures did not exhibit any differences between group E/LCS and the other groups. In particular, the incidence of performing low anterior resection, which is usually considered to

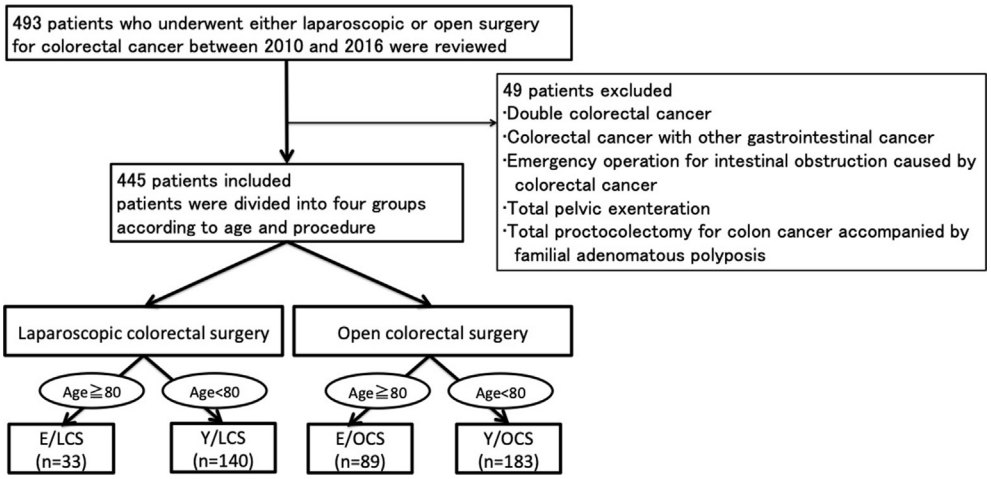

Figure 1. Study flow chart, E/LCS: Elderly/Laparoscopic colorectal surgery, Y/LCS: Young/Laparoscopic colorectal surgery, E/OCS: Elderly/Open colorectal surgery, Y/OCS: Young/Colorectal surgery.

Table 1
Preoperative patients' characteristics.

Variables	E/LCS (n = 33)	Y/LCS (n = 140)	E/OCS (n = 89)	Y/OCS (n = 183)
Patients' characteristics				
Age, years	83.3 ± 1.33	65.3 ± 0.65 P < 0.0001	84.4 ± 0.81 P = 0.137	67.3 ± 0.57 P < 0.0001
Male, n (%)	11 (33.3)	78 (55.7) P = 0.021	39 (43.8) P = 0.296	113 (61.8) P = 0.002
BMI, kg/m2	22.34 ± 0.70	24.0 ± 0.34 P = 0.065	22.1 ± 0.43 P = 0.779	22.4 ± 0.3 P = 0.904
PS (ECOG), n (%)				
0/1/2	28 (84.8)	137 (97.9) P = 0.0014	71 (79.8) P = 0.525	173 (94.5) P = 0.044
3	5 (15.2)	3 (2.1) P = 0.0014	16 (18.0) P = 0.713	7 (3.8) P = 0.009
4	0 (0)	0 (0) –	2 (2.2) P = 0.385	3 (1.6) P = 0.459
ASA-PS, n (%)				
1/2	27 (81.8)	118 (84.3) P = 0.729	57 (64.0) P = 0.06	146 (79.8) P = 0.787
3	6 (18.2)	22 (15.7) P = 0.729	32 (36.0) P = 0.06	37 (20.2) P = 0.787
≥4	0 (0)	0 (0) –	0 (0) –	0 (0) –
Location of tumor, n (%)				
Colon	24 (72.7)	82 (58.6)	78 (87.6)	109 (59.6)
Rectum	9 (27.3)	58 (41.4) P = 0.133	11 (12.4) P = 0.048	74 (40.4) P = 0.152

BMI: Body mass index.
PS: Performance status.
ECOG: Eastern Cooperative Oncology Group.
ASA-PS: American society of anesthesiologists physical status.

result in more postoperative complications, did not differ in this analysis. The operating time in group E/LCS was shorter than that in group Y/LCS; however, it was longer than that in group Y/OCS. The estimated blood loss in group E/LCS was lower than that in groups E/OCS and Y/OCS. Number of harvested lymph nodes in group Y/OCS was higher than that in group E/LCS. With regard to UICC 7th disease stage, the number of patients with stage I disease in group E/LCS was significantly higher than that in groups E/OCS and Y/OCS. Furthermore, the number of patients with Stage II disease in group E/LCS was lower than that in group E/OCS (Table 3). Table 4 displays the postoperative outcomes. The incidence of overall postoperative complications in group E/LCS was significantly lower than that in groups E/OCS and Y/OCS. However, each complication did not have a difference. In particular, complications, such as anastomotic leakage, intra-abdominal abscess, respiratory complication, and cardiovascular complication, did not occur in group E/LCS. With regard to the Clavien–Dindo classification, no patient in group E/LCS exhibited a grade ≥ III complication. In addition, postoperative hospital stays in group E/LCS were significantly shorter than those in groups E/OCS and Y/OCS.

Table 2
Preoperative comorbidities.

Variables	E/LCS (n = 33)	Y/LCS (n = 140)	E/OCS (n = 89)	Y/OCS (n = 183)
Overall comorbidity, n (%)	29 (87.9)	103 (73.6) P = 0.082	78 (87.6) P = 0.972	121 (66.1) P = 0.012
Cardiovascular, n (%)	7 (21.1)	18 (12.9) P = 0.22	24 (30.0) P = 0.517	18 (9.8) P = 0.06
AHA/ACC stage, n (%)				
≥ Stage C	3 (9.1)	1 (0.71) P = 0.004	7 (7.9) P = 0.827	4 (2.2) P = 0.039
Respiratory, n (%)	3 (9.1)	16 (11.4) P = 0.699	19 (21.4) P = 0.112	27 (14.8) P = 0.387
Severe pulmonary disease, n (%)	0 (0)	2 (1.4) P = 0.49	9 (10.1) P = 0.058	13 (7.1) P = 0.114
Cerebrovascular, n (%)	3 (9.1)	16 (11.4) P = 0.699	10 (11.2) P = 0.733	23 (12.6) P = 0.572
Hepatic, n (%)	1 (3.0)	4 (2.9) P = 0.957	1 (1.1) P = 0.461	4 (2.2) P = 0.767
Renal, n (%)	1 (3.0)	3 (2.1) P = 0.76	3 (3.4) P = 0.925	5 (2.7) P = 0.924
Hypertension, n (%)	25 (75.8)	78 (55.7) P = 0.035	70 (78.7) P = 0.732	85 (46.5) P = 0.002
Diabetes, n (%)	9 (27.3)	25 (17.9) P = 0.221	14 (15.7) P = 0.148	28 (15.3) P = 0.093
Anticoagulant therapy, n (%)	6 (18.2)	23 (16.4) P = 0.808	16 (18.0) P = 0.979	18 (9.8) P = 0.16
Chronic steroid use, n (%)	0 (0)	3 (2.1) P = 0.396	4 (4.5) P = 0.216	1 (0.55) P = 0.67

AHA/ACC: American heart association/American college of cardiology.

4. Discussion

Elderly patients usually exhibit more comorbidities than younger patients. Therefore, they are considered as high-risk patients for colorectal surgery [2]. Previous studies have demonstrated that mortality and morbidity rates of colorectal surgery increased with increasing age, with increasing comorbidity, and in males [4,23,24]. Laparoscopic surgery affects hemodynamic and the respiratory system because of pneumoperitoneum and changing position [12,13]. Therefore, surgeons are reluctant to perform LCS in elderly patients. However, with advances in the techniques of surgery and anesthesia, these patients have undergone LCS. The benefits of laparoscopic surgery in terms of a minimal invasion and earlier recovery could potentially reduce the disadvantages faced by elderly patients.

Table 3
Operative procedures and surgical/pathological findings.

Variables	E/LCS (n = 33)	Y/LCS (n = 140)	E/OCS (n = 89)	Y/OCS (n = 183)
Operative procedures				
Right colectomy/Ileocecal resection, n (%)	14 (42.4)	35 (25.0) P = 0.046	53 (59.6) P = 0.091	55 (30.1) P = 0.161
Transverse colectomy, n (%)	3 (9.1)	5 (3.6) P = 0.174	8 (9.0) P = 0.986	6 (3.3) P = 0.124
Left colectomy, n (%)	1 (3.0)	8 (5.7) P = 0.532	3 (3.4) P = 0.925	8 (4.4) P = 0.723
Sigmoidectomy, n (%)	3 (9.1)	22 (15.7) P = 0.33	12 (13.5) P = 0.512	17 (9.3) P = 0.971
High anterior resection, n (%)	6 (18.2)	33 (23.6) P = 0.505	8 (9.0) P = 0.157	40 (21.9) P = 0.635
Low anterior resection, n (%)	3 (9.1)	28 (20.0) P = 0.142	3 (3.4) P = 0.194	24 (13.1) P = 0.52
Hartmann operation/Miles' operation, n (%)	3 (9.1)	9 (6.4) P = 0.588	3 (3.4) P = 0.194	34 (18.6) P = 0.183
Surgical and pathological findings				
Operating time, min	224 ± 12.2	250 ± 5.9 P = 0.024	185 ± 7.4 P = 0.0005	231 ± 5.2 P = 0.641
Blood loss, ml	40.1 ± 66.3	52.7 ± 32.2 P = 0.30	251 ± 40.4 P < 0.0001	463 ± 28.1 P < 0.0001
Number of harvested lymph nodes	18.4 ± 2.2	18.0 ± 1.1 P = 0.83	21.6 ± 1.4 P = 0.252	23.7 ± 0.95 P = 0.049
UICC 7th disease stage, n (%)				
0	2 (6.1)	7 (5.0) P = 0.805	3 (3.4) P = 0.506	5 (2.7) P = 0.32
I	16 (48.5)	52 (37.1) P = 0.23	9 (10.1) P < 0.0001	22 (12.0) P < 0.0001
II	6 (18.2)	33 (23.6) P = 0.505	38 (42.7) P = 0.012	64 (35.0) P = 0.058
III	7 (21.2)	44 (31.4) P = 0.247	32 (36.0) P = 0.121	64 (35.0) P = 0.121
IV	2 (6.1)	4 (2.9) P = 0.366	7 (7.9) P = 0.735	28 (15.3) P = 0.158

UICC: Union for international cancer control.

Table 4
Postoperative outcomes.

Variables	E/LCS (n = 33)	Y/LCS (n = 140)	E/OCS (n = 89)	Y/OCS (n = 183)
Postoperative outcomes				
Overall postoperative complication, n (%)	5 (15.2)	29 (20.7) P = 0.419	36 (40.5) P = 0.0009	70 (38.3) P = 0.009
Surgical site infection, n (%)	2 (6.1)	4 (2.9) P = 0.366	13 (14.6) P = 0.202	30 (16.4) P = 0.124
Postoperative ileus, n (%)	2 (6.1)	8 (5.7) P = 0.939	16 (18.0) P = 0.099	21 (11.5) P = 0.63
Anastomotic leakage, n (%)	0 (0)	9 (6.4) P = 0.135	1 (1.1) P = 0.541	8 (4.4) P = 0.221
Intraabdominal abscess, n (%)	0 (0)	1 (0.71) P = 0.626	2 (2.3) P = 0.385	8 (4.4) P = 0.221
Colitis, n (%)	0 (0)	3 (2.1) P = 0.396	4 (4.5) P = 0.216	6 (3.3) P = 0.292
Respiratory complication, n (%)	0 (0)	1 (0.71) P = 0.626	3 (3.4) P = 0.286	4 (2.2) P = 0.391
Cardiovascular complication, n (%)	0 (0)	0 (0) –	0 (0) –	1 (0.55) P = 0.67
Deep vein thrombosis, n (%)	1 (3.0)	1 (0.71) P = 0.263	0 (0) P = 0.099	2 (1.1) P = 0.381
Clavien-Dindo classification, n (%)				
I	2 (6.1)	4 (2.9) P = 0.366	27 (30.3) 0.005	43 (23.5) 0.023
II	3 (9.1)	10 (7.1) P = 0.703	11 (12.4) P = 0.615	24 (13.1) P = 0.52
IIIa	0 (0)	10 (7.1) P = 0.114	5 (5.6) P = 0.164	13 (7.1) P = 0.114
IIIb	0 (0)	4 (2.9) P = 0.326	0 (0) –	3 (1.6) P = 0.459
IVa	0 (0)	1 (0.7) P = 0.626	1 (1.1) P = 0.541	2 (1.1) P = 0.546
IVb	0 (0)	0 (0) –	0 (0) –	0 (0) –
V	0 (0)	0 (0) –	1 (1.1) P = 0.541	0 (0) –
≥ II	3 (9.1)	25 (17.9) P = 0.219	18 (20.2) P = 0.148	42 (22.9) P = 0.071
Postoperative hospital stay, days	12.3 ± 2.4	14.1 ± 1.2 P = 0.482	18.4 ± 1.5 P = 0.03	18.6 ± 1.0 P = 0.0087

Because laparoscopic surgery affects hemodynamics and the respiratory system due to pneumoperitoneum and changing position, evaluating whether LCS leads to cardiovascular and/or respiratory complications in patients with cardiovascular and/or respiratory comorbidities is important. However, previous studies have not described detailed cardiac and respiratory function. In this study, patients over grade C were defined as exhibiting severe cardiac dysfunction, and severe pulmonary disease was also defined as any condition with %VC <60% and/or FEV1.0% < 50%.

In this study, the incidence of postoperative complications in group E/LCS was significantly lower than that in group E/OCS and, it was similar to that in group Y/LCS. Although low anterior resection, which has a higher risk of anastomotic leakage, was performed in group E/LCS similar to that in the other groups, no complication over Clavien–Dindo grade III was observed in group E/LCS. However, the number of males was significantly lower in group E/LCS. Male sex was reported to be a risk factor for anastomotic leakage [4]; therefore, this result might be affected by the difference in the number of males between the groups. The postoperative hospital stay in group E/LCS was shorter than that in group E/OCS. Similar to the results of previous studies, our results demonstrated that LCS would be suitable for elderly patients [14,15,21]. Although previous studies have demonstrated that age is a risk factor of postoperative morbidities [3,25,26], LCS would provide better surgical outcomes even for elderly patients.

In group E/LCS, no patient exhibited cardiovascular and/or respiratory postoperative complications, which is a concern with laparoscopic surgery. Although no patient exhibited severe pulmonary disease in group E/LCS, three patients in group E/LCS exhibited severe cardiac dysfunction. These results demonstrated that pneumoperitoneum and changing position would not have a large effect on hemodynamics and cardiac function. Therefore, LCS would possibly be safe even if patients exhibited severe cardiac dysfunction. Suzuki et al. reported that pneumoperitoneum did not influence the respiratory system and circulation in elderly patients who underwent laparoscopy-assisted distal gastrectomy [27]. However, only three patients exhibited severe cardiac dysfunction; therefore, further examination is required. To evaluate the risk of complication in elderly patients, comprehensive risk scoring taking preoperative characteristics into account might be useful. Some investigators have reported the usefulness of risk scoring for LCS, such as estimating the physiologic ability and surgical stress score, physiologic and operative severity score, or enumeration of mortality [28–30].

In this study, the number of males in group E/LCS was lower than that in groups Y/LCS and Y/OCS. One of the reasons for higher number of males was because the mean lifespan of males was approximately 10 years shorter than that of females in Japan. The rate of patients with performance status ≥3 and ASA-PS ≥ 3 was 15.2% and 18.2%, respectively. These results were comparable to those of previous studies (performance status ≥ 3: 3.0%–13.8%, ASA-PS ≥ 3:18.2%–29.9%) [14,15,21]. The overall comorbidity of group E/LCS was similar to that reported previously (64.1%–89.5%) [14,15,21]. With regard to oncological quality, the number of harvested lymph nodes in group E/LCS did not differ from that in groups Y/LCS and E/OCS. Therefore, surgical stress would not differ between the groups. The conversion rate was 4.6%, which is comparable with that reported in previous studies (2.9%–7.4%) [14,15,21].

This study has some limitations. Firstly, our study was retrospective and comprised a relatively small sample size. Secondly, selection bias existed and the decision of performing LCS was made by each surgeon. Therefore, patient perioperative characteristics, such as sex, performance status, ASA-PS score, comorbidity, cancer staging, and operative procedure, might have affected the operative outcomes. Thirdly, long-term outcomes were not assessed. In this regard, previous studies have reported that long-term outcomes did not differ between younger and elderly patients [14,15,21].

In conclusion, the incidence of severe postoperative complications was not high in elderly patients who underwent LCS compared with that in those who underwent OCS and in younger patients who underwent LCS. In addition, respiratory and cardiovascular complications were not observed in elderly patients who underwent LCS. Therefore, we suppose that elderly patients can safely undergo LCS.

Ethical approval

This study protocol was reviewed and approved by the Ethics Committee of the South Miyagi Medical Center on May 22, 2018. Registration number: 18-1.

Informed consent was waived by the Ethics Committee of the South Miyagi Medical Center.

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None.

Author contribution

KI wrote this paper and contributed to the conception of the study, critically revised the work for important intellectual content,

and approved the version to be published. KI also agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy and integrity of any part of the work were appropriately investigated and resolved.

TU contributed to the conception of the study, critically revised the work for important intellectual content, and approved the version to be published. TU also agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy and integrity of any part of the work were appropriately investigated and resolved.

NA contributed to collect medical record and also contributed to draft work.

TS contributed to collect medical records and also contributed to draft work.

TT contributed to the design of the work, drafted the work, and approved the version to be published. TT also agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy of any part of the work were appropriately investigated and resolved.

SN contributed to the design of the work and drafted the work.

KS contributed to the design of the work and drafted the work. KS also approved the version to be published and agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy of any part of the work were appropriately investigated and resolved.

SG contributed to the design of the work and drafted the work. SG also approved the version to be published and agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy of any part of the work were appropriately investigated and resolved.

MT contributed to the design of the work and drafted the work. MT also approved the version to be published and agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy of any part of the work were appropriately investigated and resolved.

HN contributed to the conception and critically revised the work for important intellectual content. HN also approved the version to be published and agreed to be accountable for all aspects of the work and for ensuring that questions related to the accuracy and integrity of any part of the work were appropriately investigated and resolved.

Conflict of interest statement

None.

Guarantor

None.

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Appendix A. Supplementary data

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