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ABOUT COVER

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Retrospective Study**Minimally invasive surgery vs laparotomy in patients with colon cancer residing in high-altitude areas**

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Abstract**BACKGROUND**

Colon cancer is associated with a higher incidence among residents in high-altitude areas. Hypoxic environment at high altitudes inhibits the phagocytic and oxygen-dependent killing function of phagocytes, thereby increasing the inflammatory factors, inhibiting the body's innate immunity and increasing the risk of colon cancer.

AIM

To examine the effect of minimally invasive surgery vs laparotomy in patients with colon cancer residing in high-altitude areas.

METHODS

Ninety-two patients with colon cancer in our hospital from January 2019 to February 2021 were selected and divided into the minimally invasive surgery and laparotomy groups using the random number table method, with 46 patients in each group. Minimally invasive surgery was performed in the minimally invasive group and laparotomy in the laparotomy group. Operative conditions, inflammatory index pre- and post-surgery, immune function index and complication probability were measured.

RESULTS

Operative duration was significantly longer and intraoperative blood loss and recovery time of gastrointestinal function were significantly less (all $P < 0.05$) in the minimally invasive group than in the laparotomy group. The number of lymph nodes dissected was not significantly different. Before surgery, there were no significant differences in serum C-reactive protein, interleukin-6 and tumor necrosis factor- α levels between the groups, whereas after surgery, the levels were

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significantly higher in the minimally invasive group (26.98 ± 6.91 mg/L, 146.38 ± 11.23 ng/mL and 83.51 ± 8.69 pg/mL vs 41.15 ± 8.39 mg/L, 186.79 ± 15.36 ng/mL and 110.65 ± 12.84 pg/mL, respectively, $P < 0.05$). Furthermore, before surgery, there were no significant differences in CD3+, CD4+ and CD4+/CD8+ levels between the groups, whereas after surgery, the levels decreased in both groups, being significantly higher in the minimally invasive group ($55.61\% \pm 4.39\%$, $35.45\% \pm 3.67\%$ and 1.30 ± 0.35 vs $49.68\% \pm 5.33\%$, $31.21\% \pm 3.25\%$ and 1.13 ± 0.30 , respectively, $P < 0.05$). Complication probability was significantly lower in the minimally invasive group (4.35% vs 17.39% , $P < 0.05$).

CONCLUSION

Laparoscopic minimally invasive procedures reduce surgical trauma and alleviate the inflammatory response and immune dysfunction caused by invasive operation. It also shortens recovery time and reduces complication probability.

Key Words: Minimally invasive surgery; Laparotomy; High-altitude area; Colon cancer; Surgical trauma; Immune dysfunction

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Core Tip: The incidence of colon cancer in high altitude areas is relatively high. We aimed to compare the curative effect of open surgery and laparoscopic surgery in high altitude areas through this study and provide evidence for the diagnosis and treatment of colon cancer in high altitude areas.

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INTRODUCTION

Colon cancer is a multiple malignant tumor of the digestive system that is associated with a higher incidence among residents in high-altitude areas. People living in these areas like to eat dairy products and red meat but consume less fruits and vegetables, so the risk of colon cancer is greater, which poses a great threat to the physical and mental health of these patients and to their quality of life[1]. A study by Frisancho *et al* [2] found that the hypoxic environment at high altitudes inhibits the phagocytic and oxygen-dependent killing function of phagocytes, thereby increasing the number of inflammatory factors such as interleukin-6 (IL-6), inhibiting the body's innate immunity and increasing the risk of colon cancer. In recent years, due to the increasing incidence of colon cancer, the safe and effective treatment have become a research hotspot[3,4].

If colon cancer is not treated timely and effectively, it results in lesion metastasis, making treatment more difficult, with worse prognosis[5,6]. Therefore, after the diagnosis of colon cancer, timely selection of the best surgical plan is vital in the treatment of these patients. Surgery is an important measure in the current clinical treatment of colon cancer, and laparotomy and laparoscopic minimally invasive surgery are commonly used[7,8]. Complete circumferential mesorectal excision is the standard treatment for colon cancer. Traditional laparotomy can be performed under direct vision and achieves certain results. However, the larger surgical trauma and higher complication probability are not conducive to the body's functional recovery[9-11]. With improvements in minimally invasive technology and the popularization of this concept, laparoscopic surgery has been applied as an important clinical minimally invasive surgery in colon cancer. This surgery can reduce surgical trauma and shorten recovery time, which play an important role in the treatment[12-14].

Here, we aimed to study the application of minimally invasive surgery and laparotomy in patients with colon cancer residing in high-altitude areas.

MATERIALS AND METHODS

General information

This study was approved by the ethics committee of our hospital. Ninety-two patients with colon cancer in our hospital from January 2019 to February 2021 were selected and divided into the minimally invasive and laparotomy groups using the random number table method, with 46 patients in each group.

In the minimally invasive group, there were 25 males and 21 females. The average age was 57.56 ± 10.91 (range: 44–71) years. In 22 patients, the Dukes stage was stage A, for 19 patients, stage B and for 5 patients, stage C. The tumor diameter was between 3.8 cm and 6.2 cm, with an average of 5.06 ± 1.10 cm. The tumor location was the cecum (in 27 patients), colon ascendens (14 patients), hepatic flexure of the colon (3 patients) and colon transversum (2 patients).

In the laparotomy group, there were 29 males and 17 females. The average age was 59.06 ± 12.11 (range: 42–76) years. In 24 patients, the Dukes stage was stage A, in 18 patients, stage B and in 4 patients, stage C. The tumor diameter ranged from 4.1 cm to 6.5 cm, with an average of 5.31 ± 1.05 cm. The tumor location was the cecum (in 24 patients), colon ascendens (15 patients), hepatic flexure of the colon (3 patients) and colon transversum (4 patients).

Selection criteria

Patients were included if: (1) The disease met the diagnostic criteria of colon cancer in surgery[15]; (2) The tumor had been confirmed *via* colonoscopy and other examinations; (3) The tumor had not been preoperatively treated; (4) The tumor could be resected after computed tomography and evaluation; (5) They lived in high-altitude areas; and (6) They provided informed consent to this study. Patients with: (1) Other benign and malignant tumors; (2) Metastatic lesions; (3) Cardiopulmonary dysfunction and inability to fully tolerate surgery; (4) Anemia and malnutrition; (5) Mental disorders; and (6) Poor compliance and inability to cooperate with investigators to complete the investigation were excluded.

Laparotomy group

In this group, laparotomy was performed. Patients were placed in the supine position for general anesthesia. The location of the tumor and surgical incision were determined. The incision was selected near the rectus abdominis, and the upper and lower intestinal tubes and vessels at the mesangial root of the tumor were ligated. The affected intestine was dissociated, the mesentery and intestine were dissected, and the intestine was sutured and fixed. The intestinal tube was clipped approximately 5 cm below the mass to check the blood supply. The enterocoelis was cleaned, a drainage tube was placed, and sutures were applied.

Minimally invasive group

In this group, minimally invasive surgery (laparoscopic radical operation) was performed. Patients were assisted to take the supine position for general anesthesia, and CO_2 artificial pneumoperitoneum was established to maintain the pneumoperitoneum pressure at 13–15 mmHg. The laparoscope and trocar were placed to investigate the internal conditions of the enterocoelis, including the lesion location, volume, metastasis and invasion. According to the treatment requirements, the colonic mesentery, peritoneum and omentum were dissociated, and the colonic mesentery was dissociated to the corresponding vascular root of the lesion. A small incision was made in the middle of the abdominal wall, and the mesangial membrane and blood vessels of the intestine were separated. If the patient had colonic convoluted tumor, the pancreatic head, gastric omentum vessels and lymph nodes under the pylorus were simultaneously removed to remove the affected tissue and tumor. The distal colon was anastomosed using a stapler and returned to the enterocoelis with intermittent suture between the peritoneum and mesentery. The incision was cleaned, and sutures were applied. Both groups were administered antibiotics for infection prevention and control after surgery.

Data analyze

The surgical conditions in the two groups, including duration, intraoperative blood loss, recovery time of gastrointestinal function and number of lymph nodes dissected were measured. The inflammatory factor [C-reactive protein (CRP), IL-6, tumor necrosis factor- α (TNF- α)] levels were measured before and after surgery in the groups. We extracted 4 mL of fasting venous blood and centrifuged it at 3000 r/min

for 15 min. The supernatant was taken and analyzed using enzyme-linked immunosorbent assay. The immune function index (CD3+, CD4+, CD4+/CD8+) before and after surgery was determined. Blood samples were taken and measured using the FACSCANTO II flow cytometry (BD Company, United States). The complication probability in the two groups was analyzed.

Statistical analysis

SPSS22.0 was used for data analysis. The measurement data were expressed as means \pm SD and were compared using *t* test. The enumeration data were expressed as *n* (%) and were compared using the χ^2 test. $P < 0.05$ indicated a statistically significant difference.

RESULTS

Clinical data for gender, age, Dukes stage, tumor diameter and tumor location were comparable between the groups ($P > 0.05$).

Comparison of surgical conditions

The operative duration was longer in the minimally invasive group (189.39 ± 20.38 min) than in the laparotomy group (145.62 ± 16.37 min), whereas intraoperative blood loss and recovery time of gastrointestinal function were less in the minimally invasive group than in the laparotomy group (101.26 ± 18.64 mL and 2.55 ± 0.39 d vs 153.22 ± 23.39 mL and 3.37 ± 0.46 d, respectively, $P < 0.05$). The number of lymph nodes dissected was not significantly different between the minimally invasive (14.26 ± 3.15) and laparotomy (15.51 ± 3.49 , $P > 0.05$) groups (Table 1).

Comparison of inflammatory factors before and after surgery

Before surgery, there were no significant differences in the serum CRP, IL-6 and TNF- α levels between the groups (9.18 ± 3.38 mg/L, 122.33 ± 16.19 ng/mL and 76.37 ± 11.25 pg/mL vs 8.97 ± 3.60 mg/L, 119.64 ± 18.02 ng/mL and 78.62 ± 13.18 pg/mL, respectively, $P > 0.05$); after surgery, these levels were significantly higher in the minimally invasive group than in the laparotomy group (26.98 ± 6.91 mg/L, 146.38 ± 11.23 ng/mL and 83.51 ± 8.69 pg/mL vs 41.15 ± 8.39 mg/L, 186.79 ± 15.36 ng/mL and 110.65 ± 12.84 pg/mL, respectively, $P < 0.05$) (Table 2).

Comparison of the immune function index before and after surgery

Before surgery, there were no significant differences in CD3+, CD4+ and CD4+/CD8+ counts between the groups ($61.23\% \pm 6.45\%$, $40.26\% \pm 4.11\%$ and 1.58 ± 0.50 vs $63.09\% \pm 5.96\%$, $39.64\% \pm 3.89\%$ and 1.62 ± 0.44 , respectively, $P > 0.05$); after surgery, the counts were lower in both groups, with CD3+, CD4+ and CD4+/CD8+ counts being significantly higher in the minimally invasive group than in the laparotomy group ($55.61\% \pm 4.39\%$, $35.45 \pm 3.67\%$ and 1.30 ± 0.35 vs $49.68\% \pm 5.33\%$, $31.21\% \pm 3.25\%$ and 1.13 ± 0.30 , respectively, $P < 0.05$) (Table 3).

Comparison of complication probability

The complication probability was significantly lower in the minimally invasive group (4.35%) than in the laparotomy group (17.39%; $P < 0.05$, Table 4).

DISCUSSION

In this study, we performed minimally invasive surgery and laparotomy for the treatment of colon cancer in patients from our hospital who were residing in high-altitude areas. The operative duration was significantly longer in the minimally invasive group, but there was no significant difference in the number of lymph nodes dissected between the groups. The amount of intraoperative blood loss was less and recovery time of gastrointestinal function was shorter in the minimally invasive group. Biondo *et al*[16] reported no significant difference between laparoscopic and laparotomy in lymph node dissection in patients with colon cancer. Although laparoscopic surgery takes longer, it is associated with less blood loss and shorter recovery time of gastrointestinal function. This is consistent with the findings from this study, suggesting that minimally invasive surgery can achieve the same effect on lymph node dissection as open surgery in patients with colorectal cancer residing in high-altitude

Table 1 Surgical conditions in the two groups (mean ± SD)

Group	Number of cases	Surgery duration (min)	Intraoperative blood loss (mL)	Gastrointestinal function recovery time (d)	Number of lymph node dissection
Minimally invasive group	46	189.39 ± 20.38	101.26 ± 18.64	2.55 ± 0.39	14.26 ± 3.15
Laparotomy group	46	145.62 ± 16.37	153.22 ± 23.39	3.37 ± 0.46	15.51 ± 3.49
<i>t</i> value		11.356	11.783	9.222	1.803
<i>P</i> value		0.000	0.000	0.000	0.075

Table 2 Inflammatory factors before and after surgery in the two groups (mean ± SD)

Time	Group	n	CRP (mg/L)	IL-6 (ng/mL)	TNF- α (pg/mL)
Before Surgery	Minimally invasive group	46	9.18 ± 3.38	122.33 ± 16.19	76.37 ± 11.25
	Laparotomy group	46	8.97 ± 3.60	119.64 ± 18.02	78.62 ± 13.18
	<i>t</i> value		0.288	0.753	0.881
	<i>P</i> value		0.774	0.453	0.381
After Surgery	Minimally invasive group	46	26.98 ± 6.91	146.38 ± 11.23	83.51 ± 8.69
	Laparotomy group	46	41.15 ± 8.39	186.79 ± 15.36	110.65 ± 12.84
	<i>t</i> value		8.842	14.404	11.872
	<i>P</i> value		0.000	0.000	0.000

CRP: C-reactive protein; IL-6: Interleukin-6; TNF- α : Tumor necrosis factor- α .**Table 3 Immune function indexes in the two groups before and after surgery (mean ± SD)**

Time	Group	n	CD3 $^{+}$ (%)	CD4 $^{+}$ (%)	CD4 $^{+}$ /CD8 $^{+}$
Before Surgery	Minimally invasive group	46	61.23 ± 6.45	40.26 ± 4.11	1.58 ± 0.50
	Laparotomy group	46	63.09 ± 5.96	39.64 ± 3.89	1.62 ± 0.44
	<i>t</i> value		1.436	0.743	0.407
	<i>P</i> value		0.154	0.459	0.685
After Surgery	Minimally invasive group	46	55.61 ± 4.39	35.45 ± 3.67	1.30 ± 0.35
	Laparotomy group	46	49.68 ± 5.33	31.21 ± 3.25	1.13 ± 0.30
	<i>t</i> value		5.825	5.866	2.501
	<i>P</i> value		0.000	0.000	0.014

regions and can reduce surgical trauma and shorten the time for functional rehabilitation. Because laparotomy is mature and can be performed under direct vision, the effect of lymph node dissection is ideal. However, laparoscopic minimally invasive surgery can be performed with the help of endoscopic amplification function, providing surgeons with a clear surgical field. It is beneficial to ensure the precision of anatomical separation, obtain sufficient tumor incisional margin and reduce trauma, which promote body function and recovery time shortening. However, laparoscopic surgery has high requirements for the operator's skills, and the uterus, small intestine and other adjacent organs during the operation will affect the operation, which prolongs the operation time to a certain extent[17,18].

Invasive surgery can activate the hypothalamic-pituitary-adrenal cortical system and promote the production of TNF- α , IL-6, cortisol and norepinephrine. CRP is also an important indicator for clinical evaluation of the degree of trauma in the body, which can reflect the degree of inflammation *in vivo*. Our results showed that CRP, IL-6 and TNF- α levels in the minimally invasive group were lower than those in the open

Table 4 Complication probability in the two groups, n (%)

Group	n	Infection	Anastomotic leakage	Urinary retention	Intestinal obstruction	Total Incidence
Minimally invasive group	46	1 (2.17)	0 (0.00)	1 (2.17)	0 (0.00)	2 (4.35)
Laparotomy group	46	3 (6.52)	2 (4.35)	1 (2.17)	2 (4.35)	8 (17.39)
χ^2 value						4.039
P value						0.044

group, which is consistent with the findings from Takemasa *et al*[19].

From the microscopic perspective of serum factors, it has been proven that laparoscopic surgery has a higher application value in cases of colon cancer in patients residing in high-altitude regions than open surgery, which can reduce the degree of inflammatory stress response caused by surgical invasive trauma and ensure safe treatment. CD3+, CD4+ and CD4+/CD8+ are important immune cells in the body. CD3+ cells are active cells that can reflect the expression of mature lymphocytes in the peripheral blood. CD4+ cells are helper T cells, whereas CD8+ cells are cytotoxic T cells. CD4+/CD8+ can reflect the immune function of the body. Studies have shown that T cells can mediate cellular immunity *in vivo*, and changes in the function and quantity of T cells are key indicators to evaluate cellular immunity. The stronger the function of T cells after colon cancer surgery, the better it can help patients eliminate residual tumor cells in the body and maintain the body's immune function[20].

The results of this study showed that CD3+, CD4+ and CD4+/CD8+ levels in the two groups after the surgery were lower than those before surgery, but the levels of all the indicators were higher in the minimally invasive group than in the open group, indicating that laparoscopic surgery imparts less damage to the immune system of patients with colon cancer residing in high-altitude areas than open surgery and is of great significance in the postoperative recovery of these patients' body functions. This is probably because laparoscopic surgery requires a small incision, which causes less damage to the body, and the inflammatory stress response caused by the invasive operation during the operation is less, which has less impact on the immune system function[21].

In addition, our findings also showed that the incidence of complications was significantly lower in the minimally invasive group than in the laparotomy group. Thus, laparoscopic surgery also has significant advantages in reducing the risk of complication probability in patients with colon cancer residing in high-altitude areas, which can ensure the effectiveness and safety of treatment of colon cancer in these patients.

CONCLUSION

Laparoscopic surgery for colon cancer in patients residing in high-altitude areas can reduce surgical trauma, alleviate inflammatory response and immune dysfunction caused by invasive surgery and thereby shorten the recovery time of body functions and reduce the risk of complications in these patients.

ARTICLE HIGHLIGHTS

Research background

Hypoxic environment at high altitudes increases the risk of colon cancer.

Research motivation

This study investigated the advantages of laparoscopic surgery in the treatment of colon cancer in the plateau area.

Research objectives

The authors aimed to examine the effect of minimally invasive surgery *vs* laparotomy in patients with colon cancer residing in high-altitude areas.

Research methods

Ninety-two patients with colon cancer were included. The surgical conditions in the two groups, including duration, intraoperative blood loss, recovery time of gastrointestinal function and number of lymph nodes dissected, were measured. The inflammatory factor levels were measured before and after surgery in the groups. The immune function index before and after surgery was determined.

Research results

The operative duration was longer in the minimally invasive group than in the laparotomy group, whereas intraoperative blood loss and recovery time of gastrointestinal function were less in the minimally invasive group than in the laparotomy group. After surgery, these levels were significantly higher in the minimally invasive group than in the laparotomy group. The counts were lower in both groups, with CD3+, CD4+, and CD4+/CD8+ counts being significantly higher in the minimally invasive group than in the laparotomy group.

Research conclusions

The results suggest that the laparoscopic surgery for colon cancer in patients residing in high-altitude areas can reduce surgical trauma, alleviate inflammatory response and immune dysfunction caused by invasive surgery and thereby shorten the recovery time of body functions and reduce the risk of complications in these patients.

Research perspectives

The advantages of laparoscopic surgery for patients with other diseases can be explored in the future.

REFERENCES

- 1 **Garrido DI**, Garrido SM. Cancer risk associated with living at high altitude in Ecuadorian population from 2005 to 2014. *Clujul Med* 2018; **91**: 188-196 [PMID: 29785157 DOI: 10.15386/cjmed-932]
- 2 **Frisancho D**, Frisancho O. [Digestive physiology and pathology in high altitude]. *Rev Gastroenterol Peru* 1992; **12**: 155-158 [PMID: 1340247]
- 3 **Klaver CEL**, Kappen TM, Borstlap WAA, Bemelman WA, Tanis PJ. Laparoscopic surgery for T4 colon cancer: a systematic review and meta-analysis. *Surg Endosc* 2017; **31**: 4902-4912 [PMID: 28432461 DOI: 10.1007/s00464-017-5544-7]
- 4 **Liu ZH**, Wang N, Wang FQ, Dong Q, Ding J. Oncological outcomes of laparoscopic vs open surgery in pT4 colon cancers: A systematic review and meta-analysis. *Int J Surg* 2018; **56**: 221-233 [PMID: 29940259 DOI: 10.1016/j.ijsu.2018.06.032]
- 5 **Yamada K**, Suzuki N, Tomochika S, Tanaka H, Tokumitsu Y, Kanekiyo S, Tokuhisa Y, Iida M, Sakamoto K, Takeda S, Yamamoto S, Yoshino S, Hazama S, Ueno T, Nagano H. [Three Cases of Obstructive Left-Sided Colon Cancer Resected by Laparoscopic Surgery]. *Gan To Kagaku Ryoho* 2018; **45**: 109-111 [PMID: 29362324]
- 6 **Okuda J**, Yamamoto M, Tanaka K, Masubuchi S, Uchiyama K. Laparoscopic resection of transverse colon cancer at splenic flexure: technical aspects and results. *Updates Surg* 2016; **68**: 71-75 [PMID: 27015933 DOI: 10.1007/s13304-016-0352-5]
- 7 **Williams AD**, Sun T, Kakade S, Wong SL, Shulman LN, Carp NZ. Comparison of open and minimally invasive approaches to colon cancer resection in compliance with 12 regional lymph node harvest quality measure. *J Surg Oncol* 2021; **123**: 986-996 [PMID: 33577718 DOI: 10.1002/jso.26298]
- 8 **Yamanashi T**, Nakamura T, Sato T, Naito M, Miura H, Tsutsui A, Shimazu M, Watanabe M. Laparoscopic surgery for locally advanced T4 colon cancer: the long-term outcomes and prognostic factors. *Surg Today* 2018; **48**: 534-544 [PMID: 29288349 DOI: 10.1007/s00595-017-1621-8]
- 9 **Cirocchi R**, Cesare Campanile F, Di Saverio S, Popivanov G, Carlini L, Pironi D, Tabola R, Vettoretto N. Laparoscopic vs open colectomy for obstructing right colon cancer: A systematic review and meta-analysis. *J Visc Surg* 2017; **154**: 387-399 [PMID: 29113714 DOI: 10.1016/j.jviscsurg.2017.09.002]
- 10 **Strey CW**, Wullstein C, Adamina M, Agha A, Aselmann H, Becker T, Grützmann R, Kneist W, Maak M, Mann B, Moesta KT, Runkel N, Schafmayer C, Türler A, Wedel T, Benz S. Laparoscopic right hemicolectomy with CME: standardization using the "critical view" concept. *Surg Endosc* 2018; **32**: 5021-5030 [PMID: 30324463 DOI: 10.1007/s00464-018-6267-0]
- 11 **Hollandsworth HM**, Amirkakhri S, Filemoni F, Hoffman RM, Molnar J, Yazaki PJ, Bouvet M. Humanized Anti-Tumor-Associated Glycoprotein-72 for Submillimeter Near-Infrared Detection of Colon Cancer in Metastatic Mouse Models. *J Surg Res* 2020; **252**: 16-21 [PMID: 32217350 DOI: 10.1016/j.jss.2020.02.017]
- 12 **Hirano Y**, Hiranuma C, Hattori M, Douden K, Yamaguchi S. Long-term oncological outcomes of

- single-port laparoscopic surgery for colon cancer. *ANZ J Surg* 2019; **89**: 408-411 [PMID: 30873699 DOI: 10.1111/ans.15076]
- 13 **Yan D**, Yang X, Duan Y, Zhang W, Feng L, Wang T, Du B. Comparison of laparoscopic complete mesocolic excision and traditional radical operation for colon cancer in the treatment of stage III colon cancer. *J BUON* 2020; **25**: 220-226 [PMID: 32277635]
- 14 **Liu Z**, Zhou T, Yang G, Zhang G. Comparison of Clinical Outcomes Between Laparoscopic-Assisted and Minilaparotomy Approaches for Colon Cancer. *J Gastrointest Cancer* 2018; **49**: 158-166 [PMID: 28154967 DOI: 10.1007/s12029-017-9923-z]
- 15 **Cappell MS**. Pathophysiology, clinical presentation, and management of colon cancer. *Gastroenterol Clin North Am* 2008; **37**: 1-24, v [PMID: 18313537 DOI: 10.1016/j.gtc.2007.12.002]
- 16 **Biundo S**, Gálvez A, Ramírez E, Frago R, Kreisler E. Emergency surgery for obstructing and perforated colon cancer: patterns of recurrence and prognostic factors. *Tech Coloproctol* 2019; **23**: 1141-1161 [PMID: 31728784 DOI: 10.1007/s10151-019-02110-x]
- 17 **Siebert M**, Trilling B, Lamotte A, Taton N, Bellier A, Faucheron JL. Similar length of colon is removed regardless of localization in right-sided colonic cancer surgery. *ANZ J Surg* 2018; **88**: E568-E572 [PMID: 29219230 DOI: 10.1111/ans.14276]
- 18 **Cui W**, Zhu G, Zhou T, Mao X, Wang X, Chen Y. Laparoscopic and conventional left hemicolectomy in colon cancer. *J BUON* 2020; **25**: 240-247 [PMID: 32277637]
- 19 **Takemasa I**, Uemura M, Nishimura J, Mizushima T, Yamamoto H, Ikeda M, Sekimoto M, Doki Y, Mori M. Feasibility of single-site laparoscopic colectomy with complete mesocolic excision for colon cancer: a prospective case-control comparison. *Surg Endosc* 2014; **28**: 1110-1118 [PMID: 24202709 DOI: 10.1007/s00464-013-3284-x]
- 20 **Choi BJ**, Kwon W, Baek SH, Jeong WJ, Lee SC. Single-port laparoscopic Deloys procedure for tension-free anastomosis after extended left colectomy or subtotal colectomy: A 6-patient case series. *Medicine (Baltimore)* 2020; **99**: e21421 [PMID: 32756144 DOI: 10.1097/MD.0000000000021421]
- 21 **Chen Q**, Shuai X, Chen L. [Safety and feasibility of the combined medial and caudal approach in laparoscopic D3 Lymphadenectomy plus complete mesocolic excision for right hemicolectomy in the treatment of right hemicolon cancer complicated with incomplete ileus]. *Zhonghua Wei Chang Wai Ke Za Zhi* 2018; **21**: 1039-1044 [PMID: 30269325]



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