



Case report

Well-leg compartment syndrome after laparoscopic surgery for rectal cancer: A case report



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ABSTRACT

Introduction and importance: Well-leg compartment syndrome (WLCS) develops from abnormal positioning of the limb during surgery. There have been few reports of WLCS in rectal cancer patients, although the lithotomy position, which is widely applied for rectal surgery, is a risk factor for WLCS.

Case presentation: A 56-year-old man with rectal cancer underwent laparoscopic low anterior resection of the rectum, left lateral lymph node dissection and diverting ileostomy. The operation time was 393 min. The patient was in the head-down tilt lithotomy position and rotated to the right side. Postoperatively, he complained of left lower leg pain and swelling and difficulty moving his legs. The compartment pressure of his right and left lower legs was 80 mmHg and 120 mmHg, respectively. A diagnosis of bilateral WLCS was made, and fasciotomy of both lower legs was performed 2 h after surgery. Although he was able to live his daily life, mild numbness remained in his toes one year after surgery.

Clinical discussion: In addition to risk factors previously reported for WLCS, our review shows that the male sex and left side are associated with a greater risk of WLCS, especially in rectal surgery. Additionally, our review reveals that the type of rectal surgery leading to WLCS is almost always laparoscopic surgery.

Conclusion: Surgeons should be especially vigilant for WLCS when they encounter patients, especially males, who complain of left lower leg pain after laparoscopic rectal surgery.

1. Introduction

Well-leg compartment syndrome (WLCS) is compartment syndrome developed from abnormal positioning of the legs [1]. WLCS is the result of increased pressure within a closed osteofascial compartment, which thus leads to venous occlusion, muscle and nerve ischemia, arterial occlusion, and tissue necrosis [2]. Some risk factors, such as the lithotomy position, for WLCS have been previously reported [3], but there have been few reports on WLCS focused on rectal surgery. We report a case of WLCS following laparoscopic low anterior resection for rectal cancer. This work was reported in line with the Surgical Case Report criteria [4].

2. Presentation of case

The patient was a 56-year-old man, 168.5 cm tall and 72.5 kg in weight (body mass index [BMI] 25.5 kg/m²). His general condition was

good and his past medical and family history was unremarkable. He was a non-smoker. He was examined for bloody stool, and colonoscopy revealed a type 2 tumor in the lower rectum. Computed tomography indicated that a left lateral lymph node was enlarged and contained a suspected metastasis. The patient was diagnosed with clinical cT3N2bM0 Stage IIIC rectal cancer (UICC, 8th edition) and underwent neoadjuvant chemoradiotherapy (capecitabine 3000 mg/body/day × 25 days + radiation 50 Gr/25 y). Response evaluation revealed a partial treatment response, and the stage was downgraded to ycT3N0M0 Stage IIA.

The patient underwent laparoscopic low anterior resection of the rectum with transanal total mesorectal excision (taTME), left lateral lymph node dissection, and diverting ileostomy under general anesthesia with thoracic epidural analgesia in the lithotomy position. The surgery was performed endoscopic surgical skill qualification system: qualified surgeons, and trainees. The patient was in a head-down (15°)

Abbreviations: WLCS, well-leg compartment syndrome; BMI, body mass index; taTME, transanal total mesorectal excision; CK, creatine kinase.

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Table 1
Compartment pressure before and after fasciotomy (mmHg).

	Right		Left	
	Before	After	Before	After
Anterior	80	10	48	18
Lateral	80	7	60	9
Superficial posterior	7	19	67	14
Deep posterior	10	11	120	24

position and rotated to the right side during surgery. Additionally, his legs were elevated to perform taTME. This position was maintained until we performed ileostomy. The operation time was 393 min, and the volume of blood loss was 120 ml.

As soon as the surgery was complete and transported to high care unit, the patient complained of difficulty moving both legs, as well as pain in his left leg. The left leg was swollen. Blood chemistry analysis revealed a high serum creatine kinase (CK) level of 12,814 U/l. The maximum right and left leg compartment pressures were 80 mmHg and 120 mmHg, respectively (Table 1), and diastolic blood pressure was 89 mmHg. Because the diastolic blood pressure minus the compartment pressures was less than 30 mmHg, we diagnosed him with WLCS of both legs. Two hours after rectal surgery, we performed fasciotomy of both legs under general anesthesia, in which the anterior, lateral, superficial posterior, and deep posterior compartments were opened (Fig. 1). After fasciotomy, the maximum right and left leg compartment pressures decreased by 19 mmHg and 24 mmHg, respectively (Table 1). His WLCS was adverse event which categorized Grade IIIb with the Clavien-Dindo Classification.

After fasciotomy, the condition of his leg wounds improved over time. On POD 15, we closed the fasciotomy wounds on both legs. On POD 22, he was able to walk completely on his own foot without a walker. On POD 29, he was discharged on foot. One year after surgery, mild numbness remained in his toes although his leg pain had disappeared. We shared him that the symptoms in his legs may remain and continue to attend him.

3. Discussion

WLCS is acute lower leg compartment syndrome that develops in the absence of trauma due to abnormal positioning during surgery [5]. The frequency of WLCS is reported to be 1:3500 for patients who undergo procedures in the lithotomy position [6]. Gill et al. [3] established the guidelines for WLCS and reported the following as risk factors for WLCS:

1: age (under 35 years), 2: obesity (with a BMI above 25 kg/m²), 3: vascular disease, 4: type of surgery (abdominopelvic surgery, laparoscopic and robotic procedures), 5: positioning (lithotomy position and Trendelenburg position), 6: duration of leg elevation and head-down tilt (over 4 h), 7: compression of lower legs (elastic socks, compression devices, compression by surgeons, etc.), and 8: fluid and blood pressure management (hypovolemia). In this case, it seemed that obesity (BMI > 25 kg/m²), long-term laparoscopic surgery (393 min) by lithotomy position and compression of the lower legs by device contributed to the occurrence of WLCS.

Recently, as laparoscopic surgery has become increasingly common for rectal cancer, reports of WLCS associated with rectal surgery are also increasing. We searched for the keywords “compartment syndrome” and “rectal cancer” in PubMed and the Japan Medical Abstracts Society and found 21 other cases in which WLCS occurred after surgery for rectal cancer (Table 2) [2,7–19]. Among all cases combined, the ratio of men to women was 20:2. The mean BMI of the patients was 25.4 kg/m². The surgical approaches included laparoscopic surgery in 21 patients (95.5%) and open surgery in 1 patient (4.5%). Long operation times (over 4 h) were reported in 21 patients (95.5%). Eighteen patients (81.8%) had left-side damage only, and four patients (18.2%) had bilateral leg damage. There were no patients with damage on the right side only. Twenty-one patients (95.5%) had pain or tenderness immediately after surgery. According to our search, obesity, laparoscopic surgery, and a long operation are risk factors for WLCS, which is consistent with Gill's guidelines [3]. Males especially seem to be sensitive to WLCS in rectal surgery. In almost cases of WLCS, laparoscopic surgery was performed. The male sex and laparoscopic surgery could be key factors for WLCS in rectal cancer.

Nishino et al. [8] reported 11 cases of WLCS after laparoscopic rectal resection. Of these 11 cases, all patients developed WLCS on the left side (left, 10; bilateral, 1). No patients developed WLCS on the right side only. This is consistent with the results of our research. Laterality is very important information for the diagnosis of WLCS. Left leg pain could also be a warning sign of WLCS in rectal cancer.

Early diagnosis is very important for the treatment of WLCS [18]. According to our research, 13 patients (59.1%) were diagnosed with WLCS the following day, although 9 patients (40.9%) were diagnosed with WLCS on the day of onset (Table 2). Delays in diagnosis may cause serious consequences, such as neuromuscular damage, skin necrosis, myoglobinuria, acute renal failure, leg amputation and even death [19]. Ignorance of WLCS among surgeons is likely the reason why so many cases go undiagnosed on the day of onset.

Addley et al. [20] recommended that the head-down angle and



Fig. 1. We performed fasciotomy of both legs. No muscular necrosis was observed.

Table 2

Cases of WLCS after surgery for rectal cancer.

Author	Publication year	Age/Sex	BMI kg/m ²	Approach	Procedure	Operation time (minutes)
Tahara et al. [7]	2019	57/M	26.4	Lap	LAR	575
		54/M	28.4	Lap	LAR	310
		67/M	22.8	Lap	APR + Lt. LLND	619
Nishino et al. [8]	2018	64/M	28.1	Lap	LAR	686
Tamai et al. [9]	2017	78/M	21.4	Lap	LAR	428
Takaoka et al. [10]	2017	76/M	24.3	Lap	S	230
		76/M	24.5	Lap	LAR	574
		65/M	25.1	Lap	LAR	536
Murakami et al. [11]	2017	56/M	23	Lap	APR	378
		84/M	26	Lap	APR	547
		52/M	34	Lap	LAR	328
Konishi et al. [12]	2016	52/M	34	Lap	LAR	328
Joutaki et al. [13]	2016	61/M	23	Lap	APR	741
Ozawa et al. [14]	2015	61/M	25.9	Lap	LAR	385
		60/M	21.1	Lap	APR	290
		40/M	21.6	Lap	ISR + Bi. LLND	331
Munakata et al. [15]	2014	40/M	21.6	Lap	ISR + Bi. LLND	331
Yoshimura and Mizumoto [16]	2013	51/M	25.4	Lap	AR	639
Takano et al. [17]	2012	69/M	22.7	Lap	AR	409
Awab et al. [18]	2011	55/F	27	Lap	Unknown	720
		74/M	24	Lap	Unknown	600
Ikeya et al. [2]	2006	67/M	29	Lap	Unknown	446
Perez et al. [19]	2004	48/F	29.7	Open	Unknown	420
Our case	2020	56/M	25.5	Lap	LAR + Lt. LLND	393

Affected leg	Pain or tenderness	Maximum compartment pressure (mmHg)	Fasciotomy	Sequelae	Time to diagnosis
Lt.	Yes	Not measured	No	Yes	Next day
Lt.	Yes	Not measured	No	No	Next day
Lt.	Yes	Not measured	No	Yes	Next day
Lt.	Yes	46	Yes	No	Next day
Lt.	Yes	96	Yes	No	2 h
Lt.	Yes	Not measured	No	No	Next day
Bi.	Yes	91	Yes	Yes	1.5 h
Lt.	Yes	30	No	No	Immediately
Lt.	Yes	Unknown	No	Yes	Next day
Lt.	Yes	Unknown	Yes	Yes	Next day
Lt.	Yes	43	No	No	Next day
Lt.	No	54	Yes	No	10 h
Lt.	Yes	22	Yes	No	Next day
Lt.	Yes	60	Yes	No	6 h
Lt.	Yes	40	Yes	No	Next day
Lt.	Yes	Not measured	Yes	Yes	Next day
Lt.	Yes	110	Yes	Yes	Next day
Lt.	Yes	Unknown	No	No	6 h
Lt.	Yes	Unknown	No	No	Immediately
Bi.	Yes	44	Yes	No	Next day
Bi.	Yes	Unknown	Yes	No	40 min
Bi.	Yes	120	Yes	Yes	2 h

M, male; F, female; Lt., left; Bi., bilateral. LLND, lateral lymph node dissection; LAR, low anterior resection; APR, abdominoperineal resection; S, sigmoidectomy; HAR, high anterior resection; ISR intersphincteric resection; AR, anterior resection.

extent of hip flexion in the lithotomy position should be within 30 and 15 degrees, respectively. In our case, the legs might have been more elevated because the patient was rotated to the right side and the legs were elevated during surgery. Excessive elevation of the legs, especially on the left side, should not be overlooked during tATME.

Prevention of WLCS requires some simple measures, such as positioning the patients carefully, limiting the duration of nonphysiological positions, reducing the flexion of the thighs on the pelvis, lowering the legs at regular intervals, periodically checking the legs to ensure that there is no pressure behind the knees, and ensuring normothermia and hemodynamically stable anesthesia [18]. To prevent WLCS, we have established new routines that we follow when performing laparoscopic rectal surgery: 1: carefully checking the fixation of the patient's trunk and legs to the operation table before starting surgery, 2: reducing the downward head tilt and right rotation after moving the small intestine, 3: leveling the patient's body every 3 h, and 4: confirming that the legs are not swelling when surgery is finished. Prevention of WLCS is important, and when WLCS occurs, early diagnosis and treatment are essential to prevent sequelae.

4. Conclusion

Aside from previously reported risk factors for WLCS, the male sex and the left side are specific risk factors for WLCS, and in almost cases, laparoscopic rectal surgery was performed.

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Ethical approval

Ethics committee approval was not required for this manuscript because it is a clinical case report.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the

written consent is available for review by the Editor-in-Chief of this journal on request.

Guarantor

The Guarantor are Tomoyuki Sugi and Yohei Owada.

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None.

CRediT authorship contribution statement

Tomoyuki Sugi and Yohei Owada contributed equally to this work; Tomoyuki Sugi and Yohei Owada performed the literature research and wrote the manuscript under the supervision of Tsuyoshi Enomoto, Yusuke Ohara, Yoshimasa Akashi and Tatsuya Oda.

Declaration of competing interest

All authors declare no conflicts of interest regarding the publication of this paper.

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