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ORIGINAL ARTICLE

Incidence and risk factors of parastomal hernia after ileal conduit diversion in Japanese population

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Abstract

Objectives To determine risk factors influencing the incidence of parastomal hernia (PH) associated with ileal conduit (IC).

Methods A total of 194 Japanese patients who underwent IC diversion followed by regular postoperative radiographic follow-up from 2005 through 2016 were enrolled. The diagnosis of PH was determined by computed tomography (CT) for patients with and without related symptoms. The cumulative incidence of PH was assessed by the Kaplan–Meier method. The log-rank test and a multivariate Cox proportional hazards model were used to evaluate risk factors associated with the incidence of PH.

Results PH was observed in 20 patients (10.3%) after a median follow-up of 25.5 months. Of the 20 patients, three were symptomatic. The cumulative incidences were 3.6%, 10.1% and 15.1% at 1, 2 and 5 years after operation, respectively. The median body mass index (BMI) was 23.1 kg/m^2 (IQR 20.4–24.6). The BMI and diameter of the passage through the rectus abdominis muscle for the IC (DPRAM) were significant predictors for PH ($p = 0.04$ and $p < 0.001$, respectively). In proportional hazards regression analysis, DPRAM $\geq$ 2.4 cm was the only independent risk factor for developing PH (HR 10.94, 95% CI 3.66–32.64).

Conclusions The incidence of PH in the current Japanese series was relatively low. Even in the population with low BMI, higher BMI might have an impact on incidence of PH. Moreover, DPRAM was also significantly associated with the incidence, suggesting that the operative procedure for creation of the passage is critical for future development of PH.

Keywords Ileal conduit · Parastomal hernia · Bladder cancer

Introduction

The ileal conduit has been the gold standard of urinary diversion for over seven decades since it was reported by Bricker [1], and is widely used after radical cystectomy. Due to its simple procedure, the ileal conduit has relatively few complications. However, several long-term complications have been reported [2]. One of the representative long-term complications is parastomal hernia (PH). Although most cases are asymptomatic and can be managed conservatively, PH can induce cosmetic and functional problems, leading to deterioration of the quality of life [3]. Moreover, bowel incarceration and strangulation can cause life-threatening conditions and require emergent repair [4, 5].

In a systematic review, the incidence of PH associated with ileal conduit was reported to be 17.1%, most instances of which were clinically overt [6]. Based on radiological diagnosis regardless of clinical signs, the incidence rose to 19.6–35.4% [4, 7]. The following risk factors of PH development have been reported: the physical characteristics of the patient, including body mass index (BMI) [4, 8, 9] and sex [4], preoperative hyponutrition [4], a history of laparotomy [8], and intraoperative factors, including operative time [7] and surgical procedures [7, 10, 11]. However, the impacts of these factors are discordant among reports and the essential etiology of PH is still unclear. Although surgeons carefully attempt to avoid PH, no effective procedure for its prevention has been established and the incidence is still significant. Some investigators have proposed the necessity of

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preventive mesh placement [5]. In this study, we aimed to determine risk factors influencing the incidence of PH.

Materials and methods

Patients

After obtaining approval of the institutional review board (acceptance number of Sapporo Medical University School of Medicine: 292–102), we retrospectively reviewed the medical records of 194 patients (154 males and 35 females) who underwent radical cystectomy and ileal conduit diversion for bladder cancer followed by regular postoperative radiographic follow-up from 2005 through 2016 at our institution.

Stoma site marking and surgical technique

Marking of the site of the ileal conduit stoma was done preoperatively by ostomy care nurse specialists and surgeons. The site was determined to be located within the rectus abdominis muscle and far from skin folds in various positions. The principle of the decision was in accord with the WOCN Society and AUA Position Statement [12]. In all cases, transperitoneal ileal conduit diversion was performed. In patients undergoing laparoscopic cystectomy, ileal conduit construction was constructed with an open procedure through the minimal mid-line incision for retrieval of the bladder. For creation of ileal conduit, a 15–20 cm segment of ileum was isolated approximately 20 cm proximal to the ileocecal junction. The proximal end of the conduit including the ureteroileal anastomotic sites was retroperitonized by suturing the posterior peritoneum to the conduit. For creation of the end stoma of the ileal conduit, a skin defect was created at the marked site. The rectus sheath was incised and the rectus abdominis muscle was separated where the ileal conduit was passed through. The ileal conduit was fixed to the anterior and posterior fasciae of the rectus abdominis muscle with interrupted 6–8 absorbable sutures. The everted end of the ileal conduit was fixed to the skin with monofilament sutures.

Radiographic evaluation and clinical parameters

All patients underwent computed tomography (CT) of the abdomen and pelvis preoperatively and every 3–6 months in regular follow-up after operation. We reviewed all CT images. The diagnosis of parastomal hernia was determined using CT for patients with and without related symptoms. Preoperative and operative parameters to determine risk factors for PH included age, sex, the body mass index (BMI), the American Society of Anesthesiologists physical status classification, the Charlson comorbidity index, concomitant diabetes mellitus, smoking status, a history of abdominal surgery, a history of radiation therapy, receipt of neoadjuvant chemotherapy, the prognostic nutrition index, the cross-sectional area of the psoas major muscle on preoperative CT, the procedure of cystectomy (open or laparoscopic), operation time, amount of bleeding, and the diameter of the passage through the rectus abdominis muscle for the ileal conduit (DPRAM, as shown in Fig. 1), which was measured on CT at 6 months after operation.

Statistical methods

Continuous variables were compared between groups using the Mann–Whitney *U* test. Categorical variables were compared between groups using the Chi-square test or Fisher exact test. The Kaplan–Meier method was used for the time to the development of PH, while differences in probability between the groups were determined with the log-rank test. Univariate and multivariate Cox proportional hazards models were used to estimate the hazard ratios and determine independent risk factors for PH development. The optimal cutoff values of continuous parameters for the prediction of the PH incidence were determined using Cutoff Finder [13]. All statistical analyses were performed with EZR, which is a graphical user interface for R (version 2.13.0; The R Foundation for Statistical Computing, Vienna, Austria) [14]. More precisely, it is a modified version of R Commander (version 1.6–3) that was designed to add statistical functions frequently used in biostatistics.

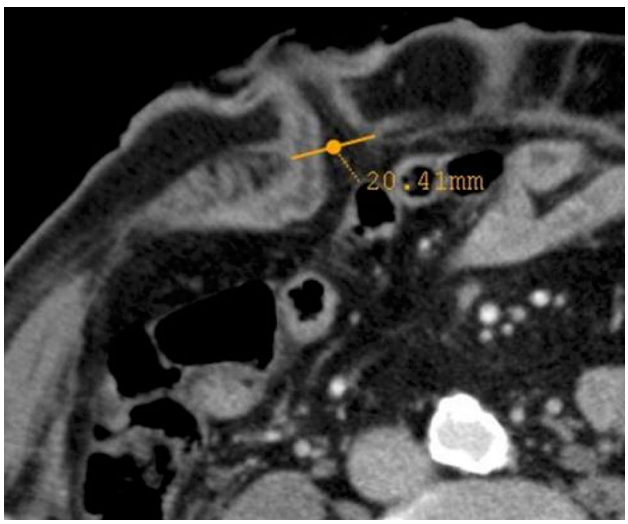

Fig. 1 Diameter of the passage through the rectus abdominis muscle for the ileal conduit measured on computed tomography

Results

The mean and median follow-up times were 37.2 and 25.5 (IQR 11.2–54.0) months, respectively. The clinical characteristics of the patients are shown in Table 1. The median age and median BMI were 70.0 years (IQR 63.0–74.8) and 23.1 kg/m^2 (IQR 20.4–24.6), respectively. PH was observed in 20 patients (10.3%) after a median follow-up of 25.5 months. Of the 20 patients, three were symptomatic. Two patients underwent open repair of the PH using non-absorbable suture, where mesh was not used. The remainder was conservatively managed with a hernia-belt. The clinical characteristics of patients with and without PH were compared. DPRAM was significantly different between patients with and without PH ($p < 0.001$). The cumulative incidences were 3.6%, 10.1% and 15.1% at 1 year, 2 years and 5 years after operation, respectively (Fig. 2a). The log-rank tests showed that BMI ≥ 22.9 kg/m^2 and DPRAM ≥ 2.4 cm were significant risk factors (Fig. 2b, c). In univariate Cox analysis, the hazard ratios for cumulative incidence of PH were 2.78 and 12.43 for BMI ≥ 22.9 kg/m^2 and DPRAM ≥ 2.4 cm, respectively. In multivariate analysis, we chose BMI and DPRAM as variables according to results of univariate analyses and other reports [4, 7–9]. DPRAM was an independent risk factor for the incidence of PH (Table 2).

Comments

PH is a common postoperative complication associated with the ileal conduit. The incidence of PH identified by radiography was 35.4% in a report from the United States [4]. High

Table 1 Comparison of characteristics of patients with and without parastomal hernia

Variables	Overall ($n = 194$)	Parastomal hernia (n)		p value
		Yes (20)	No (174)	
Age at operation (years)	70 (63–75)	72 (63–76)	69 (63–74)	0.44
No. male	159 (82.0)	14 (70.0)	145 (83.3)	0.21
BMI (kg/m^2)	21.1 (20.4–24.6)	23.9 (22.3–25.7)	22.9 (20.3–24.4)	0.12
ASA-PS	2 (2–2)	2 (2–2)	2 (2–2)	0.57
CCI	0 (0–1)	0 (0–1)	0 (0–1)	0.92
Diabetes mellitus	37 (19.1)	5 (25.0)	32 (18.4)	0.55
Current smoker	112 (57.7)	12 (60.0)	100 (57.5)	1.00
History of abdominal surgery	87 (44.8)	12 (60.0)	75 (43.1)	0.16
History of radiation therapy	22 (11.3)	1 (5.0)	21 (12.1)	0.48
Neoadjuvant chemotherapy	61 (31.4)	5 (25.0)	56 (32.2)	0.62
Preoperative PNI	47.8 (44.0–50.6)	46.9 (43.7–51.8)	47.9 (44.2–50.4)	0.94
Psoas major muscle cross-sectional area (mm^2)	1764 (1356–2152)	1648 (1294–2110)	1890 (1372–2210)	0.23
Procedure of cystectomy				0.42
Open	145 (74.7)	17 (85.0)	128 (73.6)	
Laparoscopic	49 (25.3)	3 (15.0)	46 (26.3)	
Operation time (min)	493 (436–548)	475.5 (395–565)	494.5 (445–546)	0.42
Open	494 (438–562)	472 (389–588)	495(446–558)	0.57
Laparoscopic	493 (434–525)	479 (446–479)	493 (437–526)	0.31
Amount of bleeding (mL)	1615 (692–2745)	1725 (802–2632)	1600 (1372–2210)	0.89
Open	2160 (1330–3000)*	2230 (1270–5050)*	2155 (1332–3030)*	0.67
Laparoscopic	270 (100–580)	390 (205–405)	265 (100–595)	0.68
Surgical site infection	12 (6.2)	0 (0)	12 (6.9)	0.62
Superficial	9 (4.6)	0 (0)	9 (5.2)	
Deep	3 (1.6)	0 (0)	3 (1.7)	
DPRAM (cm)	1.4 (1.1–1.8)	2.6 (2.0–3.0)	1.3 (1.0–1.6)	< 0.001

Variables are expressed as median (interquartile range) or percentage

BMI body mass index, *ASA-PS* the American Society of Anesthesiologists physical status classification, *CCI* Charlson comorbidity index, *PNI* the prognostic nutrition index, *DPRAM* diameter the passage through the rectus abdominis muscle for the ileal conduit

*$p < 0.001$ as compared with the laparoscopic cystectomy group

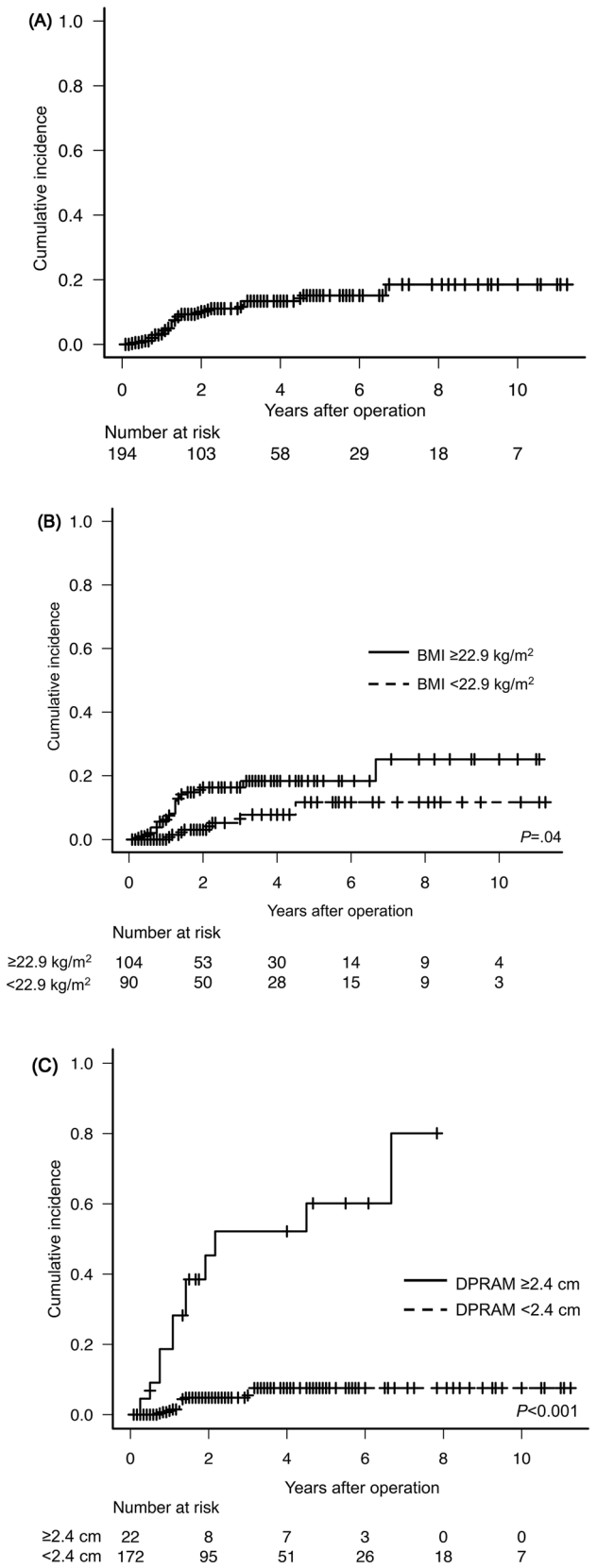

Fig. 2 **a** Overall cumulative incidence of parastomal hernia. Cumulative incidences stratified by **b** body mass index and **c** diameter of the passage through the rectus abdominis muscle for the ileal conduit. *BMI* body mass index, *DPRAM* diameter of the passage through the rectus abdominis muscle for the ileal conduit

BMI is a common risk factor for the development of PH [4, 7, 8]. Our series had much lower BMI than in other reports. That is a potential explanation for the low incidence of PH in this study. On the other hand, even in such a population, BMI was still significantly associated with the incidence of PH in univariate analyses. In Japanese cases of colostomy, Funahashi et al. [15] reported that BMI was an independent risk factor for development of parastomal hernia. Our finding is in accordance with their report. These suggest that the physical characteristics of patients have a strong impact on development of PH.

The majority of PH cases developed within two years after operation in our series, which is in accord with other reports [4, 7–9, 11]. This finding suggests that the development of PH is associated with not only the patient's characteristics, but also the surgical procedure. The impact of the type of stoma, such as an end stoma or Turnbull loop stoma, on the incidence of PH is controversial [4, 11]. Fixation of the ileal conduit to the abdominal rectus sheath has no preventive effect against PH formation [9, 10]. Instead, the size of the abdominal muscle defect may have an impact on PH development [3, 7]. Because the exact measurement at the time of creation was not available, we evaluated DPRAM on the first postoperative CT taken at around 6 months. Hussein et al. [7] showed that DPRAM ≥ 30 mm was an independent risk factor for PH formation. They assessed DPRAM at the diagnosis of PH in patients, whereas we tried to assess DPRAM on CT as soon as possible after operation to predict future development of PH. Even in this study, DPRAM was a significant risk factor of PH, suggesting that the size of the abdominal muscle defect for creation of the ileal conduit is critical for prevention of PH. It is difficult to optimize the cutoff value for the size because the size of the ileum and thickness of the mesenteric fat are different among individuals. Too small a passage may cause ischemia of the ileal segment, leading to stomal stenosis. However, we should also take care not to create too large an abdominal muscle defect. Although two fingerbreadths are widely used as an indicator for passage of the ileal conduit [4, 8], that can be too large depending on the patient.

This study has several limitations. The sample size was relatively small. Data collection and analyses were done in a retrospective manner. Multiple surgeons were involved and the surgical procedure was not standardized in detail, although mostly the same technique was employed. The time of the first postoperative CT was different among patients. In some patients, PSH had already developed at the time of

Table 2 Univariate and multivariate analyses of variables for proportional hazards regression analysis of factors for developing parastomal hernia

Variables	Univariate		Multivariate	
	HR (95% CI)	*p* value	HR (95% CI)	*p* value
BMI ≥ 22.9 kg/m^2	2.78 (1.01–7.64)	0.05	2.17 (0.81–5.80)	0.14
DPRAM ≥ 2.4 cm	12.43 (5.07–30.50)	< 0.001	10.94 (3.66–32.64)	< 0.001

BMI body mass index, *DPRAM* diameter of the passage through the rectus abdominis muscle for the ileal conduit, *HR* hazard ratio, *CI* confidence interval

measurement of DPRAM. As described above, our cohort rarely included patients with high BMIs. Therefore, application of the findings should be limited to individuals with low or average BMIs and the cutoffs of variables may not be appropriate for obese patients.

Conclusion

The radiography-based incidence of PH in the current Japanese series was lower than reported incidences in American series. Although most patients in the current series had low BMI, higher BMI might have an impact on the incidence of PH. Moreover, DPRAM was also significantly associated with the incidence, suggesting that the operative procedure for creation of the passage is critical for future development of PH.

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Compliance with ethical standards

Conflict of interest No author has any conflict of interest.

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