



Relevance of a Persistent Descending Mesocolon to Sigmoid Volvulus

Atsushi Tsuruta^{1*}, Yusaku Watanabe¹, Yasuo Oka¹, Minoru Fujita², Hiroshi Matsumoto², Yoshinori Fujiwara¹, Akiko Shiotani² and Tomio Ueno¹

¹Department of Digestive Surgery, Kawasaki Medical School, Japan

²Department of Internal Medicine, Kawasaki Medical School, Japan

Abstract

Purpose: Sigmoid Volvulus (SV) causes acute abdomen, but its mechanism of torsion still remains unknown. Persistent Descending Mesocolon (PDM) is a congenital anomaly where the primitive dorsal mesocolon fails to fuse with the parietal peritoneum in the 4th to the 5th month of gestation. We evaluated the association of PDM with SV.

Materials and Methods: We conducted a retrospective study of 45 consecutive patients (male: female=36:9, median age=77.8 years old) with SV who were treated at our hospital between 2009-2016. Relationships among computed tomography findings (Coffee Bean sign (CB), Bird Beak sign (BB), Whirl Sign (WS), and PDM), anamnesis, a history of endoscopic treatment, and grading of pathological findings were analyzed.

Results: The ratio of PDM in SV cases was higher compared with the usual frequency of occurrence. With regard to the grade of pathological findings, Univariate analysis showed significant differences in PDM and the number of endoscopic treatments. Multivariate analysis showed that only PDM was an independent factor for a low grading of inflammation of the colon.

Conclusion: PDM may be one of the causes of SV and should be one of determining factors of surgery for SV.

Keywords: Sigmoid volvulus; Persistent descending mesocolon; Coffee bean sign; Bird beak sign; Whirl sign

Introduction

The incidence of sigmoid volvulus (SV) is the largest number in volvulus of the gastrointestinal tract [1]. The ratio of men to women with SV is 1.4 to 1 and the average age is 68 years old [2]. The causes of SV are chronic fecal overloading and elongation of the sigmoid colon [3]. The predisposing factors for formation of volvulus are an abnormally long, large intestine and a narrow mesentery [4-6]. However, the etiology or mechanism of pathogenesis of SV still remains unclear. Congenital, as well as acquired factors could become reasons for torsion [2].

The diagnosis of SV may not be difficult by plain abdominal radiography findings with a "Coffee Bean Sign (CB)". Computed Tomography (CT) scan findings sometimes provide impressive images of "Whirl Sign (WS)" and "Bird's Beak Sign (BB)" [7,8].

Persistent mesocolon is an embryological anomaly that occurs during the final process of intestinal development in organogenesis. This condition is associated with an absence of fusion between the descending or ascending colon mesentery and posterior, lateral parietal peritoneum. Persistent mesocolon appears after 5 months of gestation during the developmental process [9]. Persistent Descending Mesocolon (PDM) develops as a result of failure of the primitive dorsal mesocolon to fuse with the parietal peritoneum in the 5th month of gestation [10]. In the 1960s, this abnormality was reported in the fields of radiology and gynecology [11,12]. A previous study reported that the incidence of PDM confirmed in laparoscopic colorectal surgery was 2.4% (13/543) at a representative Japanese cancer institute [13]. In our previous literature survey, only two case reports described the relevance of PDM to SV [14,15]. Therefore, the present study aimed to determine how the presence of PDM affects the occurrence of SV.

Materials and Methods

A total of 45 patients who were diagnosed and underwent treatment for SV in Kawasaki

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*Correspondence:

Atsushi Tsuruta, Department of Digestive Surgery, Kawasaki Medical School, Japan,
E-mail: atsuatsu@apost.plala.or.jp

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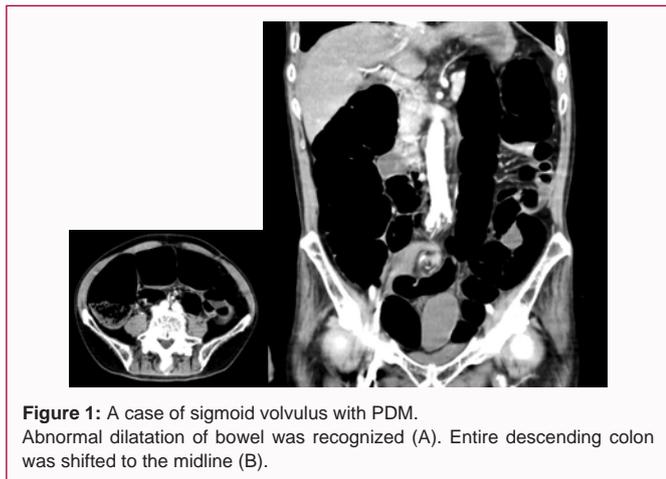


Figure 1: A case of sigmoid volvulus with PDM. Abnormal dilatation of bowel was recognized (A). Entire descending colon was shifted to the midline (B).

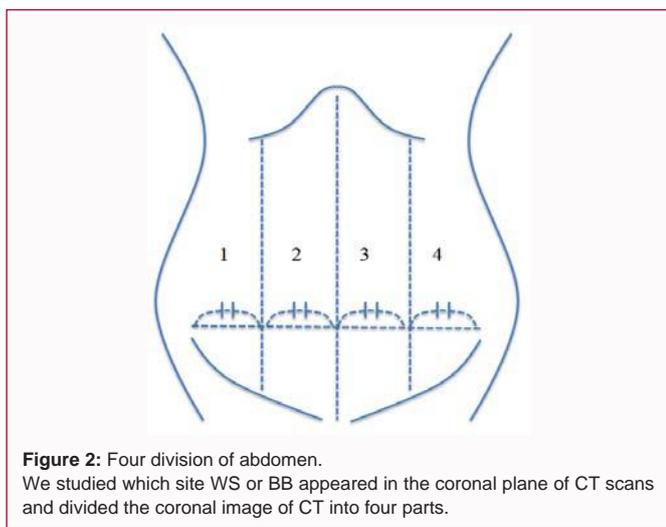


Figure 2: Four division of abdomen. We studied which site WS or BB appeared in the coronal plane of CT scans and divided the coronal image of CT into four parts.

Medical School Hospital from January 2000 to September 2016 were investigated. Patients who did not undergo CT in clinical diagnosis were excluded from the present study. This was a retrospective chart review of a prospectively maintained database. The institutional review boards of the Kawasaki Medical School approved the study protocol.

Diagnosis

All of the patients were diagnosed based on clinical symptoms together with blood tests, a plain abdominal radiograph, and CT scan findings. Plain abdominal radiographs showed a CB, and abdominal CT scans showed a WS and a BB in cases of acute abdominal obstruction. PDM was diagnosed by the coronal plane or transverse plane of CT scans. The CT findings showed that descending colon or Sigmoid-Descending junction (SD junction) shifted to the midline as a result of absence of fusion between the descending colon mesentery and posterior lateral parietal peritoneum. Figure 1 shows a case of 72 years-old male who was diagnosed as sigmoid volvulus having PDM.

Grading of inflammation by histopathological findings

Histological diagnosis was performed with all resected species. Moreover, grading of inflammation was performed depending on the degree of inflammation. We defined grading of inflammation as follows. Grade 1 (G1) was no inflammation or a microcirculatory disorder. Grade 2 (G2) was a mild ischemic change. Grade 3 (G3) was a severe ischemic change or necrotic change. We categorized all

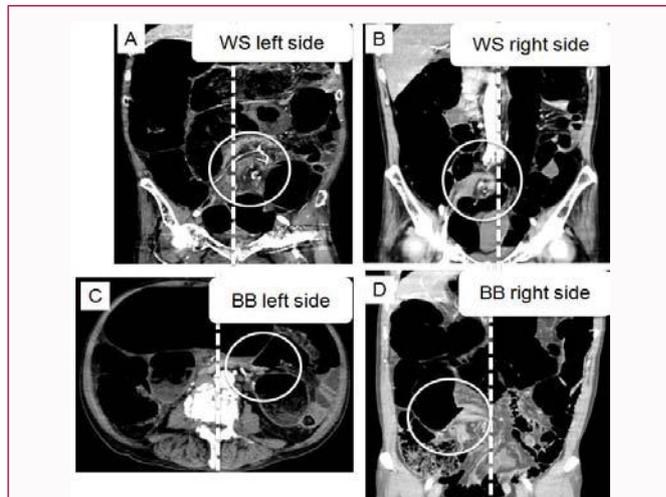


Figure 3: Positional relationship of whirl sign (WS) and bird's beak sign (BB) in abdominal CT. WS placed in left side (A) and right side (B) in abdominal CT findings. BB placed in left side (C) and right side (D) in abdominal CT findings.

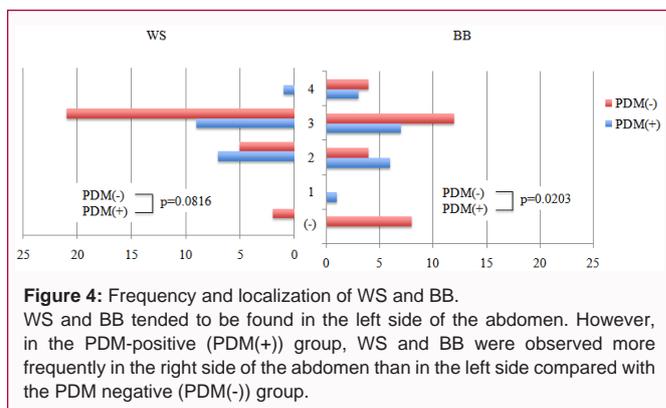


Figure 4: Frequency and localization of WS and BB. WS and BB tended to be found in the left side of the abdomen. However, in the PDM-positive (PDM+) group, WS and BB were observed more frequently in the right side of the abdomen than in the left side compared with the PDM negative (PDM-) group.

patients who underwent endoscopic therapy as G1 inflammation. Patients who had more than G2 inflammation were regarded as cases with a surgical indication.

Statistical analysis

Results are reported as mean ± SD. We used the chi-square test and t-test for analysis. Multivariate analysis was performed using logistic regression. Statistical significance was defined as a p value <0.05. All analyses were performed using JMP software version 11.2 (SAS Institute, Inc., Cary, NC).

Results

Forty-five patients underwent endoscopic or surgical treatment for SV during the study period. The ratio of males to females was 36 to 9. The median age of patients was 77.8 (47-97) years old. (Table 1) shows the patients' characteristics. Preoperative representative radiological findings showed that the ratios of CB, WS, and BB were 97.8% (44/45), 95.8% (43/45), and 82.2% (37/45), respectively. The ratio of a PDM was 37.8% (17/45), which was much higher than that reported previously [13]. The number of endoscopic treatment for SV was as follows: one was 15 cases, two were two cases, three were six cases, and four were three cases. The mean number of endoscopic treatment was 1.10 ± 1.28. During the study, surgical intervention was performed in 66.7% (30/45) of patients; in who open sigmoidectomy was performed in nine, the open Hartmann procedure in 20, and

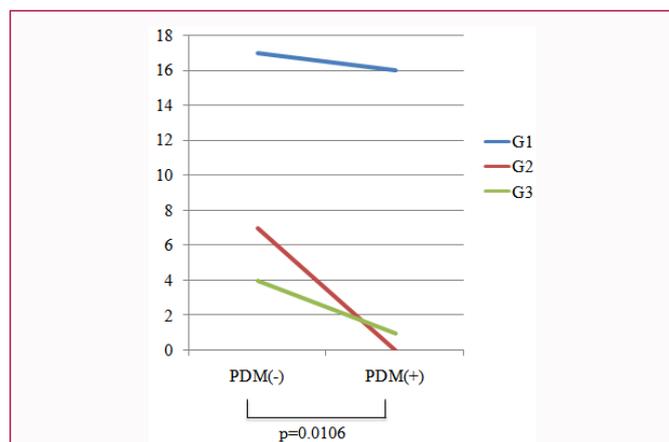


Figure 5: Causal relationship between PDM and grading of inflammation. The causal relation between PDM and the grading of inflammation was studied. In the PDM(-) group, G1 was observed in 17 patients, G2 in seven, and G3 in four. In the PDM(+) group, G1 was observed in 16 patients, G3 in one, and G2 in none. As a result, the grading of inflammation in the PDM(+) group was significantly lower than that in the PDM(-) group (p=0.0106).

Table 1: Clinical Characteristics of patients.

Patient's characteristics	
Gender (male: female)	36 : 9
Age (mean ± SD)	77.8 ± 10.2
Radiological findings	
coffee bean sign(CB)	97.8% (44/45)
whirl sign(WS)	95.6% (43/45)
bird beak sign (BB)	82.2% (37/45)
persistent descending mesocolon (PDM)	37.8% (17/25)
Number of endoscopic therapy (mean ± SD)	
1	15
2	2
3	6
4	3
Surgical intervention	66.7% (30/45)
Surgery	
open sigmoidectomy	9
Open Hartmann	20
Laparoscopic sigmoidectomy	1
Grade of inflammation	
1 (no inflammation/microcirculatory disorder)	33
2 (mild ischemic change)	7
3 (severe ischemic change/necrotic change)	5

laparoscopic sigmoidectomy in one. For the grade of inflammation, grade 1 was observed in 33 (73.3%) patients, grade 2 in (20.0%) seven, and grade 3 in five (11.1%,Table 1).

Localization of WS, BB, and presence of PDM

We studied which site WS or BB appeared in the coronal plane of CT scans. We divided the coronal image of CT into four parts (Figure 2). Figure 3 shows the positional relationship of WS and BB in abdominal CT. WS and BB tended to be found in the left side of the abdomen. However, in the PDM-positive (PDM(+)) group, WS and BB were observed more frequently in the right side of the abdomen

Table 2: Univariate analysis.

	AIS		P
	(-)	(+)	
Gender (M: F)	27:6	9:3	0.613
age			0.481
PDM (D: N)	16: 17	1: 11	0.014
WS(0/1/2/3/4)	2/0/9/21/1	0/0/3/9/0	0.734
BB(0/1/2/3/4)	7/1/7/13/5	1/0/3/6/2	0.829
CB(Y: N)	32: 1	12: 0	0.542
Number of underlying disease (0/1/2/3/4/5/6)	13/9/8/11/10/1	8/3/0/0/0/1/0	0.226
Number of Endoscopic therapy (0/1/2/3/4)	9/14/2/6/2	10/1/0/0/1	0.013

AIS: Absolute indication for Surgery

Table 3: Multivariate analysis.

	P	odds ratio (N/D)		odds ratio (D/N)	
PDM	0.011	0.0753	0.003447-0.5834	13.27	1.7139-290.1097

than in the left side compared with the PDM negative (PDM(-)) group (Figure 4). The presence of PDM would have possibility that WS and BB could not occur in the left side of abdomen.

PDM and grading of inflammation

The causal relation between PDM and the grading of inflammation was studied. In the PDM (-) group, G1 was observed in 17 patients, G2 in seven, and G3 in four. In the PDM (+) group, G1 was observed in 16 patients, G3 in one, and G2 in none. As a result, the grading of inflammation in the PDM (+) group was significantly lower than that in the PDM (-) group (p=0.0106) (Figure 5).

PDM and indication for surgery

We defined the Absolute Indication for Surgery (AIS) as grading of inflammation greater than grade 2. Namely, AIS (-) meant relative indication or maladaptation for surgery and indicated G1 as grading inflammation. Moreover, AIS (+) indicated G2 or G3. Univariate analysis showed that the number of endoscopic therapies (p=0.013) and PDM (p=0.014) were significantly associated with AIS (Table 2). In multivariate analysis, the presence of PDM was associated with decreased odds of AIS (Table 3).

Discussion

The present study is the first to report the association between SV and PDM. In most cases of PDM, a descending or proximal sigmoid colon is not adhered to the parietal peritoneum and a thin ligament often exists between them. As a result, the left-sided colon is shifted to the midline and an unusual mesenteric adhesion sometimes arises between the mesocolon and mesentery. In our study, the incidence of PDM in SV cases was more than 15 times that previously reported [13]. Moreover, two case reports described that volvulus might occur when PDM was present [14,15]. Therefore, PDM could be one of the risk factors for SV. SV is defined as a twisting or rotation of the sigmoid colon and mesocolon, leading to large bowel obstruction. CB, BB, and WS are a typical clinical trial of SV. CB is shown in plain radiographs of the abdomen and indicates that upstream and downstream of an expanded sigmoid colon are in a horizontal line. BB and WS are shown in abdominal CT scans and indicate twisting of the bowel. These two signs appeared in the midline of body (Figure 4). WS and BB in the right side of the body were observed significantly more frequently in the PDM (+) group than in the

PDM (-) group. In the presence of PDM, the whole sigmoid colon is often positioned towards the right side rather than the left side of the abdomen. Furthermore, unusual adhesions by PDM sometimes occur. Therefore, adhesions between the mesentery and mesocolon sometimes occur in the left side of body and prevent twisting of the sigmoid colon in the left side of the body. We considered that these adhesions would affect grading of inflammation of the sigmoid colon. Therefore, adhesion might make torsion incomplete. This possibility was indicated by our finding that the grade of inflammation in the PDM (+) group was significantly lower than that in the PDM (-) group (Figure 5). Additionally, multivariate analysis showed that patients with SV and PDM often recovered by endoscopic therapy, and not surgery. Therefore, patients with PDM who underwent surgery for SV were determined to have more of a relative indication than absolute indication.

This study has limitations that are inherent to a retrospective medical record review obtained at a single institution. More cases need to be studied in the future. Further prospective studies on PDM will hopefully identify an appropriate marker to provide information that is useful for deciding the line of treatment of SV.

Conclusion

The association of PDM to SV, as proposed in this study, could be useful information for future treatment policies.

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