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Laparoscopic Sigmoid Colectomy for a Patient With Sigmoid Colon Cancer and Crossed-Fused Renal Ectopia: A Case Report

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Crossed-fused renal ectopia (CFRE) is a very rare congenital renal malformation. This condition comprises several anatomic anomalies, including unilateral ureteral intersection of the midline, anteriorly-placed renal pelvises, and aberrant renal blood vessels, all of which increase the difficulty of colectomy. This report describes a case of laparoscopic sigmoidectomy with sufficient lymphadenectomy for a patient with sigmoid colon cancer and left-sided L-shaped CFRE. Preoperative computed tomography demonstrated that the origin of the inferior mesenteric artery (IMA) was free from anomalies and that the tumor did not invade surrounding organs. Therefore, we planned conventional laparoscopic sigmoid colectomy with D3 lymphadenectomy. Division of IMA at its origin and anterior colon resection was successfully performed by careful mobilization of the mesocolon to avoid exposing the retroperitoneal organs. To our knowledge, this is the first case report of laparoscopic colectomy for a patient with CFRE. Sufficient preoperative assessment of anatomic anomalies enabled successful surgery.

Key words: Crossed renal ectopia – Laparoscopic colectomy – Colon cancer

Crossed-fused renal ectopia (CFRE) is a very rare congenital renal malformation in which one kidney migrates abnormally to the opposite side and fuses with the other kidney during development. Characteristic anatomical anomalies, such as unilateral ureteral intersection of the midline, anteriorly placed renal pelvises, and aberrant renal blood vessels, must be considered when performing colectomy in these patients.[1–6] When performing radical resection of any kind of solid malignancies in a patient with anatomic anomalies of surrounding organs, one must assure sufficient oncologic clear-

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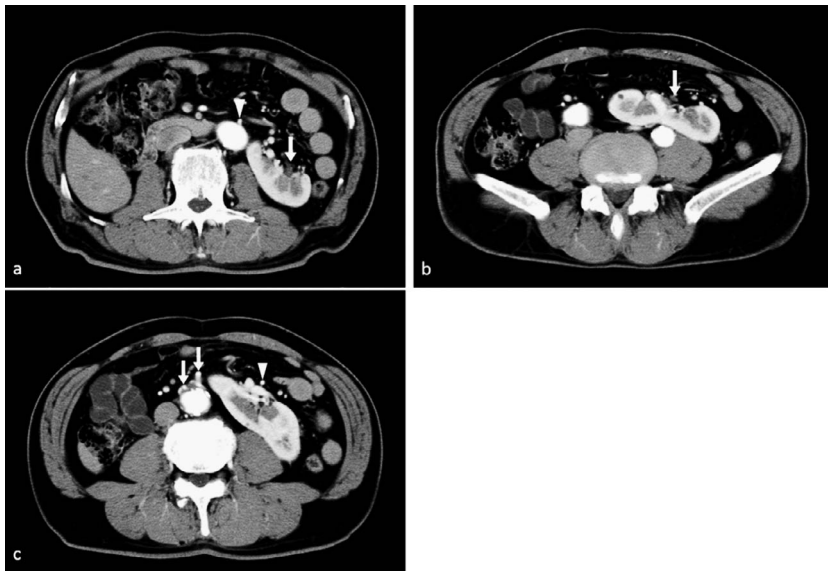

Fig. 1 (a) The cranial kidney was located where the left kidney would normally be, and the left ureter arose from the renal pelvis that was located anteriorly (arrow). The root of the inferior mesenteric artery (IMA) was distant from the fused kidney (arrowhead). (b) The caudal kidney was in front of the left common iliac artery with abnormal horizontal rotation. The right ureter arose from the renal pelvis that was located anteriorly (arrow). (c) Some aberrant renal arteries arose from the aorta above aortic bifurcation (arrows). The distal part of the IMA ran close to the fused kidney while running downward in front of the fused kidney (arrowhead).

ance and avoidance of damage to surrounding organs, or one must consider appropriate combined resection, if necessary. To achieve these goals, comprehensive preoperative assessment and planning of surgery is important. The present report describes a case in which we performed successful laparoscopic sigmoid colectomy with sufficient lymphadenectomy for a patient with sigmoid colon cancer and CFRE. Although there is no previous report describing colonic resection in patients with CFRE, we judged that D3 lymphadenectomy by dividing the origin of inferior mesenteric artery (IMA)[7] and anterior colon resection preserving the retroperitoneal organs was feasible according to preoperative computed tomography (CT) findings. The case description is followed by a review of the relevant literature.

Case Report

A 71-year-old man was evaluated at a local hospital due to a positive fecal occult blood test performed during a routine medical checkup. Detailed examination revealed sigmoid colon cancer, and the patient was referred to our hospital for treatment. He had a history of appendectomy for acute appendicitis 53 years ago and had been diagnosed with diabetes mellitus 3 years prior.

Physical examination showed a soft and flat abdomen without palpable mass. Routine laboratory examination showed no abnormal values. Assessment of tumor markers showed a high carcinoembryonic antigen (CEA) at 8.1 ng/mL, while carbohydrate antigen 19–9 (CA19–9) level was within the normal range at 17.2 U/mL.

Barium enema and colonoscopy demonstrated a circumferential type 2 tumor measuring about 4 cm from the sigmoid colon. This was judged as a cT3 lesion. Biopsy results confirmed that the tumor was a well-differentiated adenocarcinoma.

CT demonstrated swelling of local lymph nodes (cN1), and no evidence of distant metastasis (cM0).[8] CT also showed the following renal anomalies: the 2 kidneys were fused in a reversed-L shape and were left-sided, the upper moiety of the fused kidney (cranial kidney) was located where the left kidney would normally be situated (Fig. 1a), and the lower moiety (caudal kidney) was in front of the left common iliac artery with abnormal horizontal rotation (Fig. 1b). The upper margin of the fused kidney was at the level of the middle of Th12, and the lower margin was at the level of the upper edge of the sacrum. The renal pelvis of the cranial kidney, from which the left ureter originated, was located anteriorly (Fig. 1a). In the caudal kidney, the renal pelvis faced anteriorly, and the right ureter originated from this structure (Fig. 1b).

The root of the IMA branched at the level of the middle of L2 and was distant from the fused kidney. The distal part of the IMA ran close to the fused kidney while running downward in front of it (Fig. 1a and c). The right renal artery was absent, while the left renal artery flowed in the cranial kidney. Additionally, some aberrant renal arteries arose from the aorta above the aortic bifurcation (Fig. 1c).

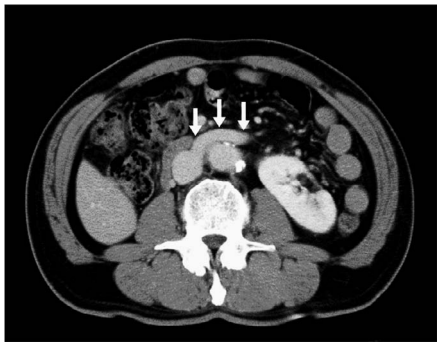

Fig. 2 The aberrant renal vein from the caudal kidney crossed in front of the aorta above the aortic bifurcation (arrows).

Two renal veins were present; one arose from the cranial kidney, and the other arose from the caudal kidney and crossed in front of the aorta above the aortic bifurcation. Both renal veins flowed into the inferior vena cava (Fig. 2).

The left ureter ran downward in front and to the left of the cranial kidney, whereas the right ureter ran downward in front of the caudal kidney followed by crossing of the midline from left to right at the level of the upper edge of the sacrum (Fig. 3). The bilateral testicular blood vessels ran alongside each ureter. No anatomic anomalies were seen in other organs.

The patient was diagnosed with sigmoid colon cancer (cT3N1M0, Stage IIIB) with CFRE, and laparoscopic sigmoid colectomy with D3 lymphadenectomy,[7] including division of IMA at its origin and anterior colon resection, was judged to be feasible and was performed. The procedure was carried out by means of a systematic approach, including ligation of the IMA root with mediolateral dissection (Fig. 4). As we had predicted preoperatively, there was no particular difficulty in dividing the IMA when compared with ordinary cases. In the process of mobilizing the mesocolon, careful dissection of the layer behind the pre-hypogastric nerve fascia was performed; that is, removal of the bilateral ureters and the left testicular blood vessels to the posterior was done. The root of the IMA was distant from the fused kidney, so adequate lymphadenectomy, including pericolic, intermediate, and main lymph nodes along the IMA, with ligation and division of IMA at its origin, was safely performed. The sigmoid colon and rectum were subsequently mobilized toward the pelvis with dissection at the layer to preserve the autonomic nerves, and the tumor was resected. End-to-end anastomosis between the descending colon and the rectum was performed using the double-stapling technique. The operative time was 219 min, and the blood loss was 23 mL. Histopathologically, the tumor was type 2, 80 $\times$ 40 mm, tub1, ly1, v0, pT3, pN0, corresponding to pStage IIA. The patient was discharged uneventfully on the seventh day after the operation. The patient remains well without any sign of recurrence and metastasis at 54 months after surgery.

Fig. 3 The right ureter crossed the midline from left to right at the level of the upper edge of the sacrum (arrow). The left ureter ran downward in front and to the left of the cranial kidney (arrowhead).

Fig. 4 Division of inferior mesenteric artery (IMA) at its origin was performed laparoscopically. The root of the IMA was distant from the fused kidney.

Discussion

The condition in which the mature kidney fails to reach its normal location is known as renal ectopia; the condition in which a kidney migrates to the side opposite that from which its ureter inserts into the bladder is known as crossed renal ectopia. Ninety percent of ectopic kidneys are fused to their

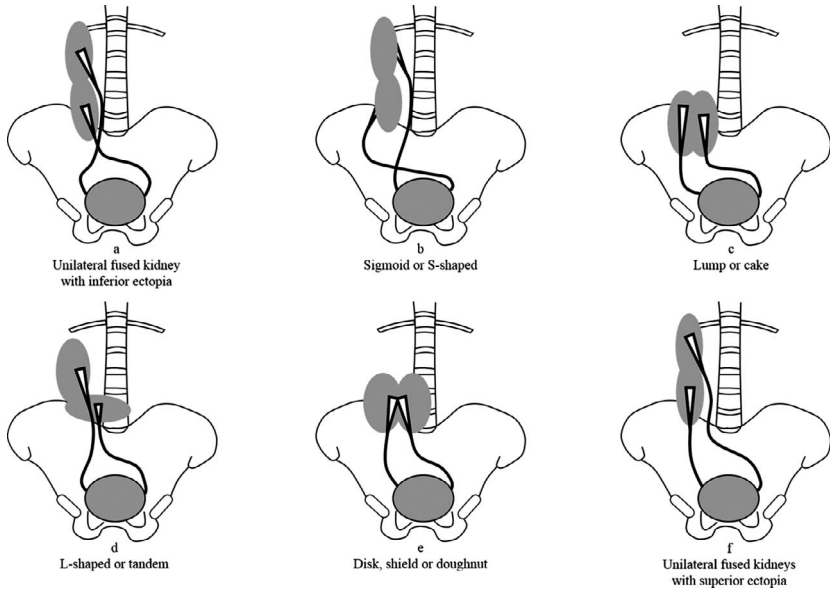

Fig. 5 Crossed-fused renal ectopia (CFRE) can be categorized into 6 subtypes according to its anatomic phenotype: (a) unilateral fused kidney with inferior ectopia, (b) sigmoid or S-shaped, (c) lump or cake, (d) L-shaped or tandem, (e) disk, shield or doughnut, and (f) unilateral fused kidneys with superior ectopia.

ipsilateral mate, and this condition is known as CFRE. The superior pole of the ectopic kidney usually joins with the inferior aspect of the normal kidney, because migration of each kidney begins simultaneously, but the ascent of the ectopic renal unit lags behind due to the crossover time.[1]

CFRE occurs in one in 1000 to 2000 live birth and is seen in 1 in 7000 to 7500 autopsies.[1–3] Aside from horseshoe kidney, which occurs in 1 in 400 births, CFRE is the most common of all renal fusion anomalies.[1,9] There is a slight male predominance (3:2), and left-to-right ectopia is seen somewhat more frequently than its counterpart.[1] Symptoms, such as palpable abdominal mass, abdominal pain, fever, hematuria and nausea, can sometimes result in diagnosis of this condition during childhood, although the majority of individuals with this malformation are asymptomatic, and the condition is only incidentally detected during adulthood.[1,4–6]

CFRE can be classified into 6 different subtypes according to its anatomic phenotype: (A) unilateral fused kidney with inferior ectopia, (B) sigmoid or S-shaped, (C) lump or cake, (D) L-shaped or tandem, (E) disk, shield or doughnut, and (F) unilateral fused kidneys with superior ectopia (Fig. 5).[1] The present case was classified as L-shaped right-to-left CFRE. L-shaped CFRE is characterized by: an ectopic kidney that abnormally rotates horizontally, location at the paramedian, renal pelvises that face anteriorly, bilateral ureters running downward in front of the fused kidney, and a ureter of the ectopic kidney that crosses the midline before inserting into the bladder at the opposite side. One or multiple aberrant renal arteries that arise from the abdominal aorta and/or iliac arteries exist in addition to the normal renal arteries.[1–6]

Thus, CFRE has several anatomic anomalies that increase the difficulty of colectomy. In particular, the relationship between the fused kidney and the IMA requires special attention. For D3 lymphadenectomy of sigmoid colon cancer, division of the origin of the IMA is required.[7] With horseshoe kidney, as reported in the Japanese literature with an English abstract, the procedure is sometimes difficult, because the IMA root is covered by the fused kidney.[10] To the best of our knowledge, colon cancer or colectomy for patients with CFRE has never been previously reported, so it is unclear whether the case in which the fused kidney is located close to IMA root exists or not. In our case, both structures were distant from each other, so that the procedure of dividing the IMA at its origin was similar to that used for ordinary cases and was safely performed laparoscopically as planned. However, when the fused kidney is close to the IMA root, open surgery should be considered for safe and radical operation.

When performing colectomy for the CFRE patient, it is also important to avoid injuring the fused kidney, ureters, gonadal vessels and the aberrant renal vein that crosses the midline during mobilization of the mesocolon. In general, dissecting the layer behind the prehypogastric nerve fascia correctly, while recognizing the autonomic nerves as the landmarks of retroperitoneal organs that should be preserved, is the key procedure of safe mobilization of the mesocolon in both open surgery and

laparoscopic surgery.[11] We found that this anatomic and surgical principle was present in the case of our CFRE patient. If combined resection of the fused kidney or urinary tract, which carries a risk of total loss of renal function, is required because of retroperitoneal invasion of the tumor, resection and reconstruction of urinary tract will be more complicated than ordinary cases. In such situations, carefully planned operation or therapeutic strategy should be prospectively performed.

We suggest that sufficient preoperative assessment and planning is necessary to perform procedures respecting the principles described above for patients with CFRE or other renal malformations.

Conclusion

We performed laparoscopic sigmoid colectomy with sufficient lymphadenectomy for a patient with sigmoid colon cancer and CFRE. Preoperative assessment of anomalies of the kidney, ureter and renal blood vessels enabled us to perform successful surgery without any complications.

Acknowledgments

The authors report no conflicts of interest.

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