

Clinicopathological Features and Surgical Outcomes of Small Bowel Metastasis from Renal Cell Carcinoma

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Small bowel metastasis from renal cell carcinoma (RCC) is rare, and its clinicopathological characteristics are unclear; thus, we revisited the concept of this tumor and reviewed its diagnostic and treatment modalities. We filtered MEDLINE searches of articles published in English between 1950 and 2019, and identified 100 patients who had undergone treatment, including 1 patient from our clinic. We extracted patient characteristics, treatment, and prognostic data, resulting in clinicopathological data on 100 patients (83 men, 17 women). Mean age was 63 years (range, 16-86 years). Tumor sites were duodenum, jejunum, ileum, and multiple sites in 30, 37, 25, and 7 patients, respectively. The 1-, 3-, and 5-year overall survival rates after diagnosis were 53.0%, 36.0%, and 36.0%. Curative resection patients showed 62.1% 5-year survival after surgery, vs. 27.5% in noncurative surgical management cases. Good prognoses can be expected if these tumors are identified early for complete removal. Surgery is the only curative option. To determine the best management strategy and improve prognostic accuracy, we continue to collect and analyze epidemiological and pathological data. Although this condition is rare, surgery should be considered if curative resection is expected. Prognosis after curative resection is not poor, but recurrence is not unlikely.

Key words: renal cell carcinoma, small bowel metastasis, intestine, tumor

The small bowel intestine is located between the stomach and large intestine and is comprised of three distinct regions: the duodenum, jejunum, and ileum. Neoplasms of the small intestine are rare, particularly when considering the size of the organ. Cancers of the small intestine account for less than 5% of all gastrointestinal cases [1]; most intestinal neoplasms are small bowel adenocarcinomas, neuroendocrine tumors, gastrointestinal stromal tumors, sarcomas, and lymphomas [2]. Reports have indicated that 49.3% of small intestinal tumors represent metastatic

cancer [3]. Recent reports have described patients with small bowel metastasis from renal cell carcinoma (RCC); however, as the number of patients who undergo resection at a single institute is limited, there have been no large studies of the clinicopathological features, therapeutic management, or surgical outcomes of small bowel metastases from RCC [4]. Generally, the standard treatment for recurrent or Stage IV RCC includes chemotherapy. However, metastasectomy, radiotherapy, or ablative techniques were also indicated for oligometastatic disease [5]. These modalities are also applied to small bowel metastases from RCC.

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To the best of our knowledge and as validated by a database search of published literature, only 99 cases have been reported for the medical management of small bowel metastasis from RCC available as comprehensive and publicly available data [4,6-93]. This study analyzed these cases to clarify the relationship between potential prognostic factors and survival time during medical management. In this article, the basic concept of small bowel metastasis from RCC is revisited, and recently published articles on both new diagnostic and treatment modalities are reviewed.

Patients and Methods

Literature search. Our systematic review was conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses statement [94]. A literature search was carried out using the following terms: “renal cell carcinoma, metastasis, small intestine,” “renal cell carcinoma, metastasis, small bowel,” and “renal cell carcinoma, metastasis, duodenum”. The MEDLINE database was searched for articles published between 1950 and 2019; other studies in the reference lists of the retrieved articles were also reviewed.

Assessments. The outcomes after curative surgical management for small bowel metastasis from RCC were investigated, as were patterns in the incidence of this condition. This study was approved by the Ethics Committee of the Kochi Health Sciences Center.

Statistical analyses. Continuous variables are described as means±standard deviation (SD). Categorical variables are presented as absolute numbers and percentages. Statistical analyses were performed using the Mann–Whitney *U*-test for continuous variables, Fisher’s exact test for categorical variables, and the Cox proportional hazards regression model for multivariate analysis. All statistically significant preoperative and perioperative variables were included to establish the model. Survival rates were generated using the Kaplan–Meier method and compared using the log-rank test. All *P*-values reported were two-sided, with an alpha level of 0.05 considered statistically significant. Statistical analyses were completed using EZR software (Saitama Medical Center, Jichi Medical University, Saitama, Japan).

Results

Patient treated in our hospital. A 56-year-old man with right-sided abdominal pain was referred to our hospital for further evaluation. He had undergone a laparoscopic right nephrectomy for RCC 4 years prior and had also received radiation therapy for brain metastasis as well as duodenum-preserving pancreatic head resection for pancreatic metastasis. The levels of tumor markers, including carbohydrate 19-9 and carcinoembryonic antigen, were within the normal ranges. Contrast-enhanced abdominal computed tomography (CT) revealed an intussusception of the ileum (Fig. 1) without ischemia. Considering small bowel metastasis from RCC (based on his medical history), small bowel resection was preoperatively planned. Laparotomy revealed no intra-abdominal metastases, except for the intussusception; segmental resection of the ileum was thus performed. Gross observation of the resected specimen revealed a polypoid lesion with a maximum diameter of 50 mm (Fig. 2A). Histopathological examination revealed a neoplasm with clear cytoplasm and atypical nuclei (Fig. 2B,C); immunohistochemistry confirmed the diagnosis [AE1/AE3 (+), PAX8 (+), vimentin (+), CD10 (+)] (Fig. 2D-G). This profile, along with the morphology, was consistent with metastatic RCC. The patient’s postoperative course was uneventful, and he was discharged 7 days after surgery. During the 11-month follow-up period, pulmonary metastases were detected, and surgery was performed. Thirteen

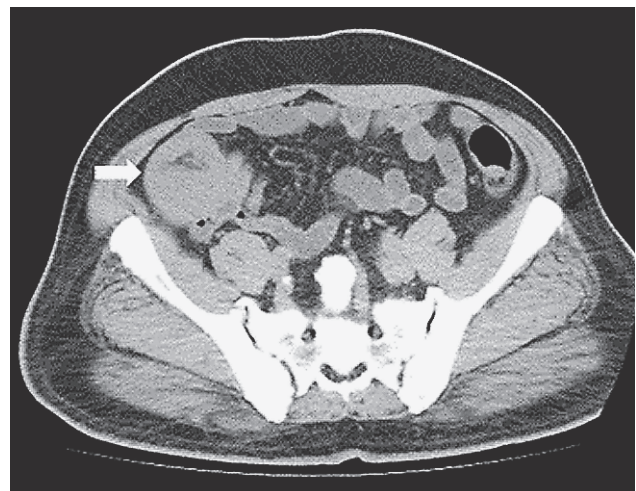


Fig. 1 Plain abdominal computed tomography (CT) scans revealed an intussusception of the ileum (arrow).

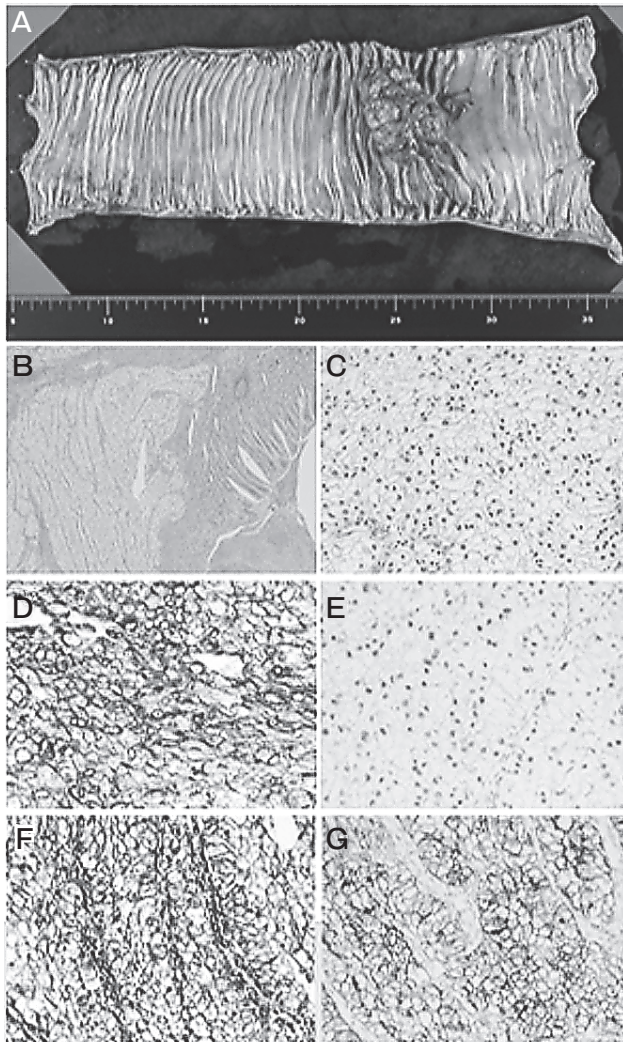


Fig. 2 A, Gross observation of the resected specimen revealed a polypoid lesion with a maximum diameter of 50 mm; B, C, Histopathological examination revealed neoplasms with clear cytoplasm and atypical nuclei (B. low-power field, C. high-power field); D-G, Immunohistochemistry confirmed the diagnosis. D, AE1/AE3 (+); E, PAX8 (+); F, vimentin (+); G, CD10 (+).

months after surgery, he is still alive without new recurrence.

Literature review. We identified 67 articles available in electronic databases by searching PubMed, and 22 articles from other sources (Fig. 3). Our survey of the literature from 1950 to 2019 identified 99 patients who had undergone medical management for small bowel metastasis from RCC [4,6-93], plus 1 patient from our clinic whose tumor was located in the ileum. All cases were diagnosed and indicated for medical treatment

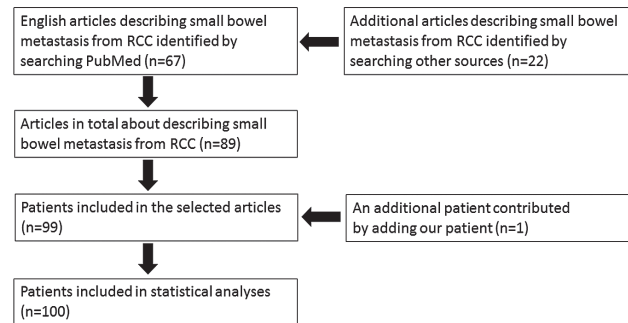


Fig. 3 Preferred Reporting Items for Systematic reviews and Meta-Analyses design showing selection of articles and cases for review.

approaches in the individual departments. The clinicopathological data described in these case reports include clinical symptoms, tumor locations, types of operation, tumor sizes, recurrence sites, and survival times [4,6-93]. The published diagnoses for the medical management of all patients were true indications for small bowel metastasis from RCC.

Clinical features of small bowel metastasis from RCC. Of the 100 patients with small bowel metastasis from RCC for whom comprehensive data were available, 83 cases occurred in men and 17 in women; the mean patient age was 63 years (range, 16-86 years). The clinicopathological characteristics of these cases of small bowel metastasis from RCC are shown in Table 1. The tumors were located in the duodenum, jejunum, and ileum of 30, 37, and 25 patients, respectively, as well as across multiple sites in 7 patients. In a single case, the patient did not exhibit symptoms; all of the remaining 99 patients were diagnosed with clinical symptoms. The symptoms included melena or hematochezia in 42, abdominal pain in 30, nausea or vomiting in 19, jaundice in 7, fatigue in 7, anorexia in 4, abdominal distention in 2, and constipation in 1 patient. The incidence of jaundice was significantly higher in the duodenum than in other parts of the small intestine ($p=0.001$).

Diagnosis of small bowel metastasis from RCC. The diagnostic modalities of small bowel metastases depend on the tumor location. In the duodenum, tumors were detected via esophagogastroduodenoscopy (EGD), CT scan, gastrointestinal series, and angiography in 21, 6, 2, and 1 patient, respectively (Table 1). In the jejunum and ileum, they were diagnosed via CT scan, small bowel endoscopy, capsule endoscopy, gas-

Table 1 Clinical characteristics for small bowel metastasis from RCC

Characteristics	Duodenum (n=30)	Jejunum (n=37)	Ileum (n=25)	Multiple sites (n=7)	P-value
Age	63.2 ± 13.7	60.4 ± 10.7	64.8 ± 8.4	62.7 ± 11.2	0.499
Gender (male/female)	24/6	31/6	20/4	7/0	0.817
Symptoms (%)					
melena or hematochezia	14 (46.7)	15 (40.5)	10 (40.0)	3 (42.9)	0.958
abdominal pain	4 (13.3)	14 (37.8)	9 (36.0)	2 (28.6)	0.060
nausea or vomiting	6 (20.0)	8 (21.6)	5 (20.0)	0 (0)	0.742
jaundice	7 (23.3)	0 (0)	0 (0)	0 (0)	0.0007
fatigue	4 (13.3)	2 (5.4)	1 (4.0)	0 (0)	0.510
fever	2 (6.7)	0 (0)	0 (0)	0 (0)	0.289
anorexia	2 (6.7)	2 (5.4)	0 (0)	1 (14.3)	0.339
abdominal distention	0 (0)	0 (0)	2 (8.0)	0 (0)	0.199
constipation	0 (0)	0 (0)	1 (4.0)	0 (0)	0.323
Diagnostic modality					<0.0001
EGD	21 (70.0)	0 (0)	0 (0)	0 (0)	
enteroscopy	0 (0)	7 (18.9)	2 (8.0)	0 (0)	
capsule endoscopy	0 (0)	4 (10.8)	2 (8.0)	1 (14.3)	
colonoscopy	0 (0)	0 (0)	2 (8.0)	0 (0)	
GI series	2 (6.7)	5 (13.5)	1 (4.0)	1 (14.3)	
CT scan	6 (20.0)	18 (48.6)	20 (80.0)	2 (28.6)	
angiography	1 (3.3)	2 (5.4)	0 (0)	1 (14.3)	
operation	0 (0)	2 (5.4)	1 (4.0)	2 (28.6)	

RCC, renal cell carcinoma; EGD, esophagogastroduodenoscopy; GI, gastrointestinal; CT, computed tomography.

trointestinal series, and angiography in 38, 9, 7, 6, and 3 patients, respectively. As expected, small bowel metastasis from RCC was detected in 5 patients during the operation; tumors were not determined according to any preoperative imaging modalities.

Pathologic features of small bowel metastasis from RCC. Approximately 80% of small bowel metastases from RCC were solitary tumors; for the 100 patients with available data, the median size was 4.0 cm (range, 1.1-11 cm) (Table 2). Small bowel metastasis from RCC occurred at higher UICC stages of primary RCC, especially when present across multiple sites of the small bowel ($p=0.038$). Of the 69 specimens whose subtypes were confirmed, histopathology revealed clear cell carcinomas, adenocarcinomas, granular cell carcinoma, and spindle cell carcinoma in 61, 6, 1, and 1 patient, respectively. Although the incidence of small bowel metastasis from RCC requiring medical management has been gradually increasing, according to Cochran-Mantel-Haenszel statistics, there were no significant differences in trends (Table 2).

Treatment. Operative demographics are shown in Table 2. The operative techniques included segmental resection of the small bowel, pancreaticoduodenec-

tomy, total pancreatectomy, diverting gastrojejunostomy, and jejunojunostomy in 68, 6, 1, 1, and 1 patient, respectively ($p<0.001$). Nonsurgical approaches performed included transarterial embolization, biliary stent, chemotherapy, radiation therapy, endoscopic resection, and argon plasma coagulation in 5, 5, 3, 2, 1, and 1 patient, respectively (Table 3). Five patients were not treated due to their poor general condition and tumor progression (*i.e.*, metastases to other sites). Chemotherapy included interferon alpha in 1 patient, sorafenib and everolimus in another, and pazopanib in the third. Of the 80 patients who underwent surgery, newly recurrent lesions were detected after surgery in 14 patients. Metastatic sites included the brain in 4 patients, liver in 3, lung in 2, lymph nodes in 2, skin in 2, peritoneum in 1, and small intestine in 1 patient. For tumors at the duodenum, no recurrent sites were specified after surgery.

Prognosis. Survival outcome data were available for 67 cases of metastasis caused by RCC, including the patient in our hospital. The overall 1-, 3-, and 5-year survival rates after diagnosis were 53.0%, 36.0%, and 36.0%, respectively (Fig. 4). Of these patients, the overall 5-year survival rate was 62.1% in patients who

Table 2 Pathological characteristics for small bowel metastasis from RCC

Characteristics	Duodenum (n=30)	Jejunum (n=37)	Ileum (n=25)	Multiple sites (n=7)	P-value
Type of surgery					<0.001
segmental resection	4	32	25	7	
pancreaticoduodenectomy	6	0	0	0	
total pancreatectomy	1	0	0	0	
bypass surgery	1	1	0	0	
others	3	0	0	0	
The number of solitary tumor (%)	24 (80.0)	26 (70.2)	20 (80.0)	1 (14.3)	0.008
Size of the tumor (cm)	4.9 (± 3.1)	4.1 (± 1.9)	4.9 (± 2.5)	2.5 (± 0.9)	0.295
Initial UICC Staging of renal cell carcinoma (%)					0.038
Stage 1	1 (8.3)	3 (15.8)	5 (50.0)	0 (0)	
Stage 2	5 (41.7)	4 (21.1)	0 (0)	0 (0)	
Stage 3	5 (41.7)	4 (21.1)	3 (30.0)	1 (25.0)	
Stage 4	1 (8.3)	8 (42.1)	2 (20.0)	3 (75.0)	
histopathologic cell type (%)					0.978
clear cell carcinoma	15 (93.8)	22 (91.7)	18 (90.0)	6 (100.0)	
adenocarcinoma	1 (6.2)	1 (4.2)	1 (0.5)	0 (0)	
granular cell carcinoma	0 (0)	1 (4.2)	0 (0)	0 (0)	
spindle cell carcinoma	0 (0)	0 (0)	1 (0.5)	0 (0)	

RCC, renal cell carcinoma.

Table 3 Treatment and recurrence pattern for small bowel metastasis from RCC

Characteristics	Duodenum (n=30)	Jejunum (n=37)	Ileum (n=25)	Multiple sites (n=7)	P-value
Treatment					<0.001
surgery	15	33	25	7	
chemotherapy	2	1	0	0	
radiotherapy	2	0	0	0	
embolization	4	1	0	0	
others	10	2	0	0	
Reccurrence sites after surgery					0.284
brain	0	1	1	2	
lung	0	2	0	0	
liver	0	1	2	0	
lymph nodes	0	2	0	0	
skin	0	1	0	1	
small intestine	0	0	1	0	
peritoneum	0	0	1	0	
others	0	0	2	0	

RCC, renal cell carcinoma.

underwent curative resection for small bowel metastasis from RCC and 27.5% in patients who underwent non-curative resection ($p=0.003$) (Fig. 5). Overall survival in patients suffering from advanced small bowel metastasis from RCC, with no operative management, was extremely poor ($p=0.017$) (Fig. 5). In univariate analyses, age (< 65 vs. ≥ 65 years), sex, maximum tumor size

(< 4 vs. ≥ 4 cm), number of tumors (solitary vs. multiple), tumor location, and timing of small bowel metastases (synchronous vs. metachronous) were not significantly associated with survival time (Table 4). In the Cox proportional hazards regression analysis, however, patients with solitary tumors lived longer than those with multiple tumors (median survival time, 24 vs. 9

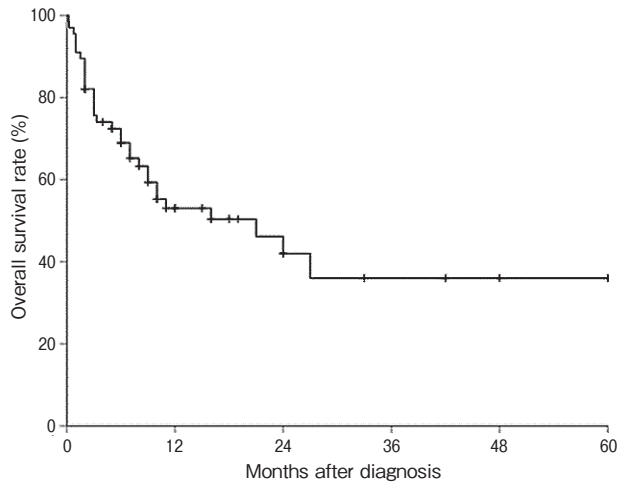


Fig. 4 Overall survival for all patients with small bowel metastasis from RCC for whom data were available.

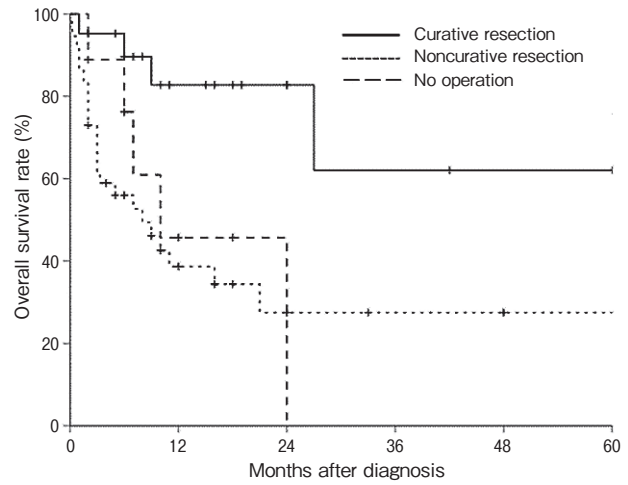


Fig. 5 Comparison of overall survival for patients with small bowel metastasis from RCC who had undergone curative resection, noncurative resection, or no operation.

Table 4 Prognostic characteristics of small bowel metastases from RCC

Characteristics	n	Survival rate (%)			Median survival in months ± SD	Univariate analysis P-value	Multivariate analysis	
		1-year	3-year	5-year			Hazard ratio	P-value
small bowel metastasis	100	53.0	36.0	36.0	21 ± 7.9			
Gender								
Male	82	53.9	32.5	32.5	21 ± 7.4	0.891	1.555 (0.2980–8.117)	0.600
Female	17	56.2	56.2	56.2	NA			
Age								
≥ 65	44	58.5	25.7	NA	21 ± 7.3	0.552	1.502 (0.4474–5.039)	0.510
< 65	54	50.8	50.8	50.8	168 ± 0			
Maximum size of the tumor (cm)								
≥ 4	32	60.8	NA	NA	27 ± 9.8	0.619	2.029 (0.6433–6.397)	0.227
< 4	25	67.0	50.3	50.3	NA			
The number of the tumor								
multiple	24	32.5	32.5	32.5	9 ± 2.4	0.121	2.983 (1.063–8.371)	0.037
solitary	72	62.7	37.8	37.8	24 ± 5.1			
Location of the tumor								
Duodenum	30	67.5	54.0	54.0	168 ± 0	0.309	0.8306 (0.3805–1.813)	0.641
Jejunum	37	40.8	20.4	NA	9 ± 2.5			
Ileum	25	60.3	42.2	42.2	21 ± 8.4			
multiple part	7	50.0	NA	NA	5 ± NA			
Timing of metastases								
Metachronous	89	52.6	44.0	44.0	16 ± 7.3	0.597	0.5484 (0.0934–3.218)	0.505
Synchronous	9	57.1	19.0	19.0	24 ± 15.7			
Resection status								
Curative resection	21	38.7	27.5	27.5	168 ± 36.1	0.007	0.2371 (0.0810–0.6931)	0.009
Noncurative resection	37	82.7	62.1	62.1	8 ± 14.4			
No operation	9	45.7	NA	NA	10 ± NA			

RCC, renal cell carcinoma; SD, standard deviation; NA, not applicable.

months, $p=0.037$). A significant difference was also recognized in resection status ($p=0.009$). Although there was no significant difference in overall survival rates, median survival time was longer with metastases in the duodenum than in the jejunum or ileum (168 vs. 16 months, $p=0.275$). However, patients with solitary tumors tended to live longer than those with multiple tumors (median survival time, 24 vs. 9 months, $p=0.121$).

Patterns over time. Patterns in reported cases over time are summarized in Table 5. The cases were divided into three groups depending on when they were reported: early (reported in 2000 or before), middle (from 2001 to 2010), and recent (2011 or later). Five patients (18.5%) were diagnosed intraoperatively in the early group. Only 1 patient was diagnosed during oper-

ation from 2001 on. In addition, 22 (66.7%) patients in the middle group and 21 (46.7%) in the recent group were diagnosed using preoperative CT scans. No significant differences were recognized between the three groups in the number of solitary tumors, tumor size, or timing of metastasis. However, regarding treatment, the proportion receiving chemotherapy increased over time, while that receiving embolization decreased ($p=0.029$). Therefore, median survival time increased from 2 to 10 months ($p=0.038$).

Discussion

Although locoregionally treated small bowel metastasis from RCC is extremely rare (2-4%), an autopsy

Table 5 Changing trends for small bowel metastasis from RCC

Period	-2000 (n=28)	2001-2010 (n=31)	2011- (n=41)	P-value
Age ± SD (years)	59.4 ± 13.3	63.5 ± 10.5	63.9 ± 9.7	0.237
Gender (male/female)	23/4	25/6	34/7	0.944
Diagnostic modality (%)				NA
EGD	11 (40.7)	4 (12.1)	6 (13.3)	
enteroscopy	0 (0)	3 (9.1)	6 (13.3)	
capsule endoscopy	0 (0)	0 (0)	7 (15.6)	
colonoscopy	1 (3.7)	0 (0)	1 (2.2)	
GI series	4 (14.8)	3 (9.1)	2 (4.4)	
CT scan	4 (14.8)	22 (66.7)	21 (46.7)	
angiography	2 (7.4)	1 (3.0)	1 (2.2)	
operation	5 (18.5)	0 (0)	1 (2.2)	
Location of the tumor (%)				0.071
Duodenum	14 (50.0)	7 (22.6)	9 (22.5)	
Jejunum	7 (25.0)	10 (32.3)	20 (50.0)	
Ileum	5 (17.9)	10 (32.3)	10 (25.0)	
Multiple sites	2 (7.1)	4 (12.9)	1 (2.5)	
The number of solitary tumor (%)	19 (76.0)	23 (76.7)	30 (73.2)	0.955
Size of the tumor ± SD (cm)	3.00 ± 3.19	4.15 ± 2.19	4.15 ± 2.20	0.726
Timing of metastases (%)				0.826
Synchronous	3 (11.1)	2 (6.5)	4 (10.0)	
Metachronous	24 (88.9)	29 (93.5)	36 (90.0)	
Initial UICC Staging of renal cell carcinoma				0.894
Stage 1/2/3/4	1/2/3/2	2/2/5/6	6/5/6/6	
Treatment (%)				0.029
surgery	19 (65.5)	27 (79.4)	33 (64.7)	
chemotherapy	2 (6.9)	5 (14.7)	10 (19.6)	
radiotherapy	1 (3.4)	1 (2.9)	3 (5.9)	
embolization	5 (17.2)	1 (2.9)	0 (0)	
others	2 (6.9)	0 (0)	5 (9.8)	
Median survival in months ± SD	2.0 ± 11.3	9.0 ± 8.1	10.0 ± 33.3	0.038

RCC, renal cell carcinoma; SD, standard deviation; EGD, esophagogastroduodenoscopy; GI, gastrointestinal; CT, computed tomography; UICC, Union for International Cancer Control; NA, not applicable.

study revealed that metastasis to the intestines was observed in 229 of 1571 (14.6%) RCC patients [46,95]. A systematic review of 16 studies including 2350 patients sought to identify the evidence base of local treatment strategies for metastases from RCC [96]. The results consistently point towards the benefit of complete metastasectomy for overall survival; however, there is selection bias. The results have to be interpreted with caution; therefore, no consensus can be reached to identify cases that require locoregional treatment of metastases, including small bowel metastasis. To our knowledge, this is the first study to report the clinicopathologic features and surgical outcomes of 100 cases of small bowel metastasis from RCC through a retrospective analysis.

RCC is regarded as a highly vascularized tumor with a rich lymphatic return and frequent metastases. During hematogenous or lymphatic metastasis, tumor cells invade the adjacent tissue and enter the hematogenous or lymphatic stream. The tumor cells are arrested during circulation and colonize new locations [97,98]. Of the 100 patients studied, melena or hematochezia was the main symptom in 42 patients with small bowel adenocarcinoma, significantly higher than the 7% figure (32 of 491 patients) reported previously ($p < 0.001$) [99]. Moreover, 38 patients presented with bowel obstruction, including intussusception; this ratio did not differ significantly from that reported for small bowel adenocarcinoma (21 of 57 patients; $p = 1.0$) [100]. Due to the difficulty of diagnosing small bowel metastases from RCC, only 5 of 9 patients with lesions located in the jejunum or ileum underwent an exploratory laparotomy before 1990; there was no exploratory laparotomy for duodenal lesions. EGD was the most useful diagnostic modality for duodenal tumors in 20 of 30 patients; since CT scans have emerged, they have contributed to the accurate preoperative diagnosis of the disease, location, and number of tumors [45]. Meanwhile, since 25% of patients suffered from multiple small bowel tumors, no metastatic lesions should be overlooked. In one autopsy study of 554 patients with RCC, distant metastases were revealed in 119 cases (21.5%), including 88 (15.9%) with multiple metastases [101]. In the present study, at the time of diagnosis of small bowel metastases, the involvement of other metastatic organs was found in 60 patients.

Our study revealed that the percentages of curative resections, noncurative resections, and nonsurgical

interventions for small bowel metastases were 32.0%, 47.0%, and 20%, respectively. The number of patients who survived without recurrence after curative resection was 18 of 32 (56.3%). Due to multiple metastases caused by RCC, curative surgical resection remains difficult; however, longer recurrence-free survival was achieved in cases where curative resection for small bowel metastases was performed. The reasons for the absence of operative indications in 18 patients included multiple metastases in 8 patients and bone and brain metastasis in 1 patient each. The 5-year survival rate was much higher after curative resection (62.1%) than after noncurative resection ($p = 0.003$). Because curative resection was considered a prognostic factor for longer survival time, surgery is strongly recommended if the tumor is expected to be completely resected [45]. The most common recurrence site after surgery was the brain ($n = 4$) followed by the liver ($n = 3$), lungs ($n = 2$), and lymph nodes ($n = 2$). Interestingly, there was no recurrence after surgery for tumors in the duodenum; although the difference was not significant, the 5-year survival rate was higher than at other sites ($p = 0.309$). The tumors of the duodenum were located at the proximal site of the gastrointestinal tract, causing gastrointestinal symptoms earlier than at other sites; additionally, the bile duct was considered more susceptible to compression by the tumor than the small bowel due to its narrow lumen, which caused jaundice early. There have been reports of metastasectomy for other abdominal organs; Staehler reported 5-year overall survival rates of 62.2% with and 29.3% without operation for liver metastasis caused by RCC [102]. In addition, a systematic review of pancreatic metastasis caused by RCC reported a 5-year overall survival of 72.6% with operation, compared to 14% without operation [103]. Thus, that study supported surgery for small bowel metastasis from RCC especially in cases of expected curative resection.

For patients with metastases caused by RCC, chemotherapy using interferon alpha or molecular-targeted drugs such as sunitinib was recommended to extend prognosis [104]; however, 2 of the 3 patients without operation in the present study died within one year. In addition, although postoperative adjuvant chemotherapy was performed in 8 patients, only 2 survived without recurrence. Currently, chemotherapy is not considered an effective treatment for patients with RCC; further examinations of chemotherapy using new agents

will improve outcomes in patients with this condition. In fact, the present study revealed that the proportion of chemotherapy performed has been increasing and thereby median survival time has been extending.

The present study has several limitations associated with the errors and biases inherent in small retrospective studies. A major limitation is that the results could not be simply estimated, as they were obtained only from published case reports. Another limitation is that the information in each case report is both limited and biased; therefore, obtaining more accurate data and determining the best management strategy for these tumors will require collection and analysis of further epidemiological and pathological data.

In conclusion, although small bowel metastasis from RCC is rare, surgery should be considered if curative resection is expected. Although the prognosis after curative resection is not poor, the possibility of recurrence is not low. More epidemiological and pathological data should be collected to establish an appropriate treatment strategy for this entity.

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