Observational Study

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Clinical features and prognostic factors of spinal metastatic pancreatic cancer

A retrospective observational study

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Abstract

Pancreatic cancer is an aggressive malignant cancer that shows the lowest survival rates. Recently, the 5-year survival rate of pancreatic cancer has been increasing, owing to early diagnosis and therapeutic advancement. The purpose of this study was to investigate the clinical characteristics and significant prognostic factors of spinal metastatic pancreatic cancer. Seventeen patients diagnosed with spinal metastases originating from pancreatic cancer from January 2005 to December 2022 were divided into 2 groups: those who underwent spinal surgery and those who did not. We collected patients' demographic data, clinical features, prognosis, and radiologic data. Age, sex, neurologic symptoms, symptom duration, metastasis location, non-neurologic symptoms, adjuvant therapy, overall survival, survival after spinal metastasis, pain score, and quality of life were compared. The average age was 64.05 (50–80) years. The average interval from pancreatic cancer diagnosis to spinal metastasis diagnosis was 12.53 (0–39) months. Eleven patients underwent spinal surgery, while six did not. Preoperative European Cooperative Oncology Group performance status score of the surgery group was 1.91 ± 1.04 and that of the non-surgery group was 2.5 ± 0.84. Survival time after spinal metastasis in the surgical group was 6.14 ± 6.0 months, while that in the non-surgery group was 2.54 ± 2.38 months. The 1-year survival rate after spinal metastasis was 18% in the surgical group, while that of the non-surgery group was 0% (P = .042). Pancreatic cancer patients with spinal metastases showed poor prognoses and extremely short survival rates. Despite poor prognosis, appropriate surgical treatment may improve prognoses.

Abbreviations: MRI = magnetic resonance imaging, NRS = numerical rating scale, OS = overall survival, SS = survival after spinal metastasis, TS = total score.

Keywords: pancreatic cancer, prognosis, spinal metastasis, spinal surgery, survival

1. Introduction

Pancreatic cancer is a well-known global burden and is one of the most aggressive malignant cancers, with the lowest 5-year survival rates. It is associated with a substantial number of mortalities every year, and its total disability-adjusted life years estimate was 9.08 million globally in 2017.[1] Most of these cases were locoregionally advanced at their first diagnosis.[2] Pancreatic cancer mostly metastasizes to the liver and peritoneal cavity, but metastasis to the lung, bone, and brain occasionally occur.[3] While the exact figures vary depending on the study, Peixoto et al[4] reported 144 cases of metastasis of pancreatic origin (59%). Metastases generally involved the following locations: approximately 42% in the peritoneum, 41% in the liver while 14% in the lungs and 4.8% in the bones.[4]

Recently, the 5-year survival rate of pancreatic cancer has been increasing owing to its earlier diagnoses. Management of pancreatic cancer includes surgery, radiation therapy, and chemotherapy. However, research into pancreatic cancer metastasis is limited. Surgical treatment is not considered the gold standard in cases of entire spinal metastasis. Instead, the neurologic, oncologic, mechanical, and systemic framework devised by Memorial Sloan-Kettering Cancer Center has stated that radiation therapy is the treatment of choice for radioactive cancer types. Moreover, in patients without severe cord compression symptoms or spine instability, radiosurgery is the first choice.[5] However, studies on the effectiveness of radiation treatment for spinal metastatic pancreatic cancer have shown conflicting results.[6]

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Guidelines for managing spinal metastatic pancreatic cancer tend to focus on neurologic symptoms and spinal instability, although none proved to be lacking. Since rates of spinal metastatic pancreas cancer is increasing, we aimed to evaluate the efficacy of surgical management. This was achieved by comparing the clinical characteristics and prognostic factors of spinal metastatic pancreatic cancer treated surgically and non-surgically.

2. Materials and methods

2.1. Patient population

Data were collected retrospectively from a single institutional database. As shown in Figure 1, a total of 532 patients were diagnosed with spinal metastasis and 481 were treated in our neurosurgery center from January 2005 to December 2022. Among them, patients diagnosed with pancreatic cancer were screened for histology records and National diagnostic code reviews, and 17 patients with spinal metastatic pancreatic cancer were included. The patients with metastatic tumors other than spinal metastatic pancreatic cancer were excluded. Patients' clinical data records were reviewed, including age, sex, initial symptoms, duration of medication, tumor stage, progression date, date of death, histologic features, and neurology. In addition, radiologic studies, surgery records, and responses to questionnaires for performance and pain were retrospectively analyzed.

Application of surgical treatment was determined based on several criteria. Patients with spinal metastatic pancreatic cancer with neurological abnormalities due to spinal cord compression and patients with instability and severe pain due to bone destruction caused by spinal metastatic pancreatic cancer underwent surgery. Patients unable to tolerate surgery owing to their systemic condition or without severe cord compression received conservative therapy. This study was approved by the Institutional Review Board of our hospital (IRB-MDB-2022-010).

2.2. Data collection

Clinical and imaging data and surgical reports of each patient were reviewed. For radiologic evaluation, patients underwent computed tomography scanning, magnetic resonance imaging (MRI), and positron emission tomography to identify other metastases and to stage pancreatic cancer.

We evaluated patients for pain (numerical rating scale [NRS]),[7] neurologic status (Eastern Cooperative Oncology Group score,[8] Frankel score[9]), prognostic value (revised Tokuhashi score,[10] Tomita score,[11] and spinal instability neoplastic score).[12] All scoring measurements were estimated by retrospective review of electronic medical charts and patient questionnaires. Patients self-scored their pain with the NRS pain scoring system. Scores for the surgical intervention group were estimated preoperatively and 1-month postoperatively, and scores of the non-surgery group were estimated twice, 1 month apart. Both pain and expected prognosis were evaluated with classic tools such as the revised Tokuhashi and Tomita scores, which are devised for evaluating spinal metastasis.

2.3. Surgical therapy

Eleven patients underwent surgical intervention due to severe pain, neurological symptoms, and spinal instability. Each procedure was chosen based on the patient's symptoms and radiologic

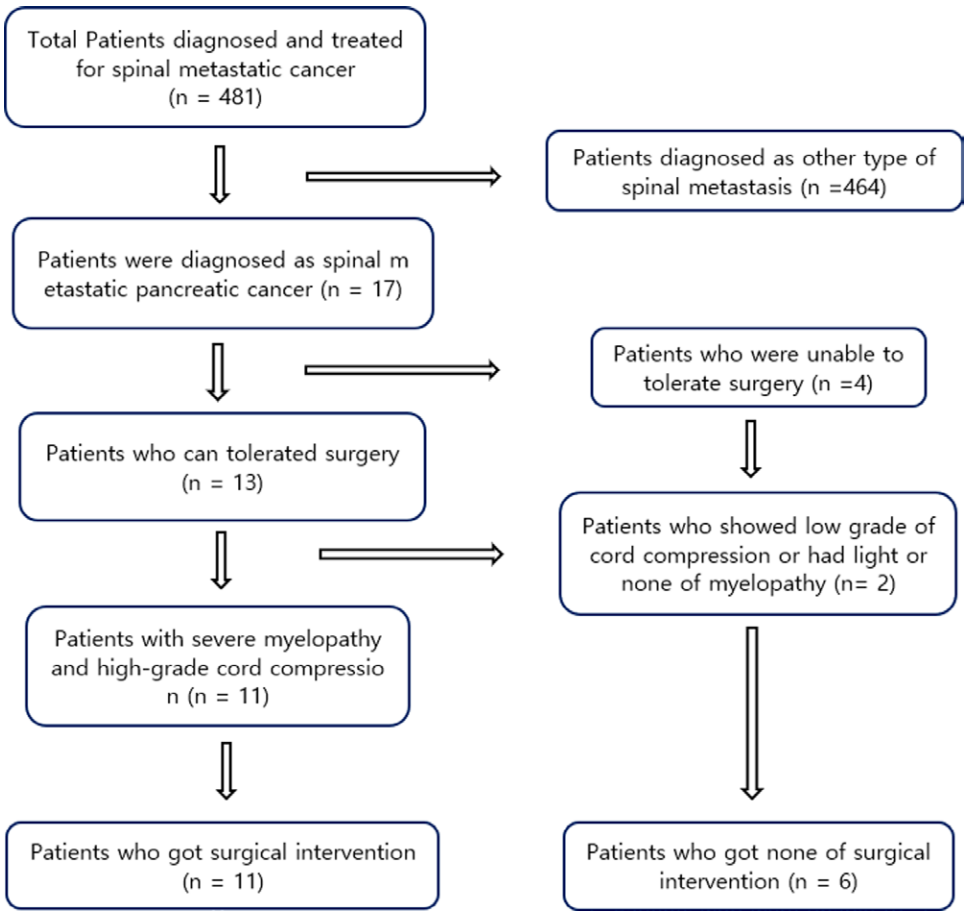

Figure 1. Flow chart.

Table 1

Patient demographics.

Case no.	Sex	Age	Symptoms	TNM staging	Metastasis location	Spinal surgical intervention & operation name (extent of resection)	Time to surgery from the clinical onset (d)	Adjuvant therapy
1	F	54	Pain	T4 N1 M0 Stage3	C, T, S	Corpectomy C4 & Anterior fusion C3-4-5	16	RTx
2	F	65	Pain Paraplegia	T3 N1 M0 Stage2B	T	Decompression T4-5 & Posterior fixation T3-4-5-6	11	RTx
3	M	71	Pain	Stage4	C, T, L, S	Decompression L3-4-5 & Posterior fixation L2-3-4-5-S1	16	RTx
4	M	71	Pain	T3 N1 M1 Stage4	L	Decompression L2-3-4 & Posterior fixation L1-2-3-4-5	16	RTx/CTx
5	F	80	Pain Paraplegia	T4 N1 M1 Stage4	C, T	Decompression T3 & Posterior fixation T2-3-4-5	6	RTx/CTx
6	M	63	Pain	T3 N0 M0 Stage2A	C	Corpectomy C7 & Anterior fusion C6-T1	19	RTx/CTx.
7	F	57	Pain	Tx Nx M1 Stage4	C	Corpectomy C6 & Anterior fusion C5-7	20	RTx
8	M	54	Pain	Tx Nx M1 Stage4	C	Corpectomy C6 & Anterior fusion C5-7	13	RTx
9	F	62	Pain	Tx Nx M1 Stage4	C	Corpectomy C4 & Anterior fusion C3-4-5	15	None
10	F	74	Pain	T3 N2 M1 Stage4	L	Decompression L2-3-4 & Posterior fixation L1-2-3-4-5	17	RTx
11	M	71	Pain	Tx Nx M1 Stage4	C, T, L, S	Decompression L4-5 & Posterior fixation L3-4-5-S1	21	RTx
12	M	50	Pain	T4 N1 M1 Stage4	L	No surgical treatment	-	RTx/CTx
13	F	71	Pain	T3 N0 M0 Stage2A	T, L	No surgical treatment	-	RTx/CTx
14	M	47	Pain	T3 N0 M0 Stage2A	L	No surgical treatment	-	RTx/CTx
15	M	60	Pain	T3 N1 M1 Stage4	T	No surgical treatment	-	RTx/CTx
16	M	60	Pain Paraplegia	T3 N1 M0 Stage2B	T, L	No surgical treatment	-	RTx/CTx
17	M	79	Pain Paraplegia	T3 N0 M0 Stage2A	T	No surgical treatment	-	None

C = cervical, CTx = chemotherapy, F = female, L = lumbar, M = male, RTx = radiotherapy, T = thoracic.

Table 2

Patient clinical characteristics.

Case no.	ECOG Score	ASIA impression	Frankel Score	Tomita Score	Revised Tokuhashi Score	SINS Scoring	SS (mo)	Pre op NRS	Post op NRS	NRS Change
1	1	E	D	10	3	11	1.9	5	3	2
2	2	D	C	8	4	10	12.27	8	4	4
3	3	D	D	10	1	8	1.4	8	6	2
4	1	D	D	10	4	9	5.27	7	2	5
5	3	B	B	10	1	14	6.57	10	4	6
6	1	E	E	8	7	11	21.7	9	3	6
7	1	B	E	10	3	9	7.07	4	2	2
8	2	D	E	8	4	11	3.2	5	3	2
9	2	D	D	10	1	13	5.1	6	2	4
10	1	C	E	10	4	9	2.03	4	2	2
11	4	C	D	10	4	10	3.07	5	2	3
12	1	E	E	8	6	6	6.6	7	6	1
13	3	D	D	10	2	13	1.57	8	7	1
14	3	D	D	10	2	8	1.17	9	8	1
15	2	D	D	10	4	7	0.34	7	6	1
16	3	C	C	10	2	10	1.29	7	6	1
17	3	C	C	10	4	10	4.2	9	8	1

ASIA = American spinal injury association, ECOG = eastern cooperative oncology group, NRS = numeric rating scale, SINS = spinal instability neoplastic scores, SS = survival after spinal metastasis.

data. Most underwent tumor removal and fixation of vertebra for stability.

2.4. Palliative therapy

As radiation is the treatment of choice for spinal metastasis, several patients received only palliative radiation treatment, while others underwent concurrent chemoradiotherapy. These non-surgical therapies were performed by oncologists at our center.

2.5. Statistical analysis

All data were analyzed using SPSS software (SPSS, Chicago, IL). Counting data were described by proportion and frequency. Overall, all data were primarily analyzed using an

independent 2 sample *t* test, and the findings were presented as mean ± standard deviation or counts (percentage), as indicated. Additionally, Mann–Whitney *U* test was performed owing to the small sample size, and the results are shown as median with range. To compare the survival distributions, overall survival (OS) and survival after spinal metastasis (SS) were analyzed using Kaplan–Meier curve and log-rank test. OS was defined as "from first diagnosis of cancer to death," and SS as "from spinal metastasis diagnosis to death." Further, univariate regression analysis was used to evaluate effective variables for survival prognosis in spinal metastatic pancreatic cancer.

Table 3

Comparison between surgery and non-surgery group.

Variables	Spinal surgery = No (N = 6)	Spinal surgery = Yes (N = 11)	*P* value
Age, yr	61.17 ± 12.19	65.64 ± 8.5	.449
Sex, n (%)			
Female	1 (16.7)	6 (55)	.123
Male	5 (83.3)	5 (45)	
Tumor stage			
1	0 (0)	0 (0)	.108
2	4 (66.67)	2 (18.2)	
3	0 (0)	1 (9.1)	
4	2 (33.33)	8 (72.7)	
Paraplegia			
No	4 (66.67)	8 (72.7)	.816
Yes	2 (33.33)	3 (27.3)	
Resection of primary tumor			
No	5 (83.33)	7 (63.6)	.399
Yes	1 (16.67)	4 (36.4)	
Adjuvant Tx			
None	1 (16.67)	1 (9.1)	.247
RTx	0 (0)	6 (54.7)	
CTx	3 (50)	3 (27.3)	
Both	2 (33.33)	1 (9.1)	
ECOG	2.5 ± 0.84	1.7 ± 0.82	.226
ASIA	3.83 ± 0.75	3.7 ± 1.06	.659
Frankel	3.83 ± 0.75	4.1 ± 0.99	.55
Revised Tokuhashi	3.33 ± 1.63	3.2 ± 1.87	.945
Tomita	9.67 ± 0.82	9.4 ± 0.97	.636
Change of NRS	1	3.5 ± 1.72	<.001*
SINS	9 ± 2.53	10.5 ± 1.9	.249
SORG Classic	5.83 ± 0.75	3.5 ± 0.53	.378
Overall survival (mo)	18.78 ± 12.17	16.58 ± 18.88	.775
Survival after spinal metastasis (mo)	2.54 ± 2.38	6.14 ± 6	.101

ASIA = American spinal injury association, CTx = chemotherapy, ECOG = eastern cooperative oncology group, NRS = numeric rating scale, RTx = radiotherapy, SINS = spinal instability neoplastic scores, SORG = skeletal oncology research group.
*Statistically significant.

3. Results

3.1. Patient demographics

Full demographic, perioperative data are described in Table 1. Seventeen patients were included in the analysis. Twelve (70.5%) were male; the average age was 64.06 (range, 50–80) years; 7 (41%), 9 (53%), 8 (47%), and 2 (12%) patients had metastatic lesions in the cervical, thoracic, lumbar, and sacral regions, respectively. The average time from first pancreatic cancer diagnosis to diagnosis of spinal metastases was 12.53 (range, 1–39) months. The most common initial symptoms were severe pain and paralysis due to cord compression. All patients complained of pain and 4 complained of pain accompanied by paraplegia. Among the 17 patients, 11 patients underwent surgery (5 corpectomy and Cage insertion/6 decompression and fixation), and 6 patients did not. All but 1 patient in each group underwent adjuvant treatment with radiotherapy or chemotherapy. In this study, no postoperative complications were found.

3.2. Clinical characteristics of patients

Patient scores for performance, pain, predicted prognosis, and spine instability are shown in Table 2. Patients scored their pain and performance with standardized questionnaires at the beginning of the treatment process. All patients who underwent surgery showed improvement in pain. Prognosis scoring was based on clinical data; Tomita scores ranged from 8 to 10 and revised Tokuhashi scores from 1 to 7, predicting bad prognosis.[11] In spinal instability neoplastic score evaluation, a total score (TS) > 12 indicated an unstable spine, and a TS from 7 to 12 indicated a potentially unstable spine.[13] TS > 7 is recommended for surgical intervention to be considered, and all patients in this study met this criterion. Though all patients' Tomita and revised Tokuhashi scores predicted poor prognose, we instead focused on patients' present discomfort and quality of life. Uncontrolled severe pain, acute paralysis, and spinal instability were enough to warrant surgical treatment.

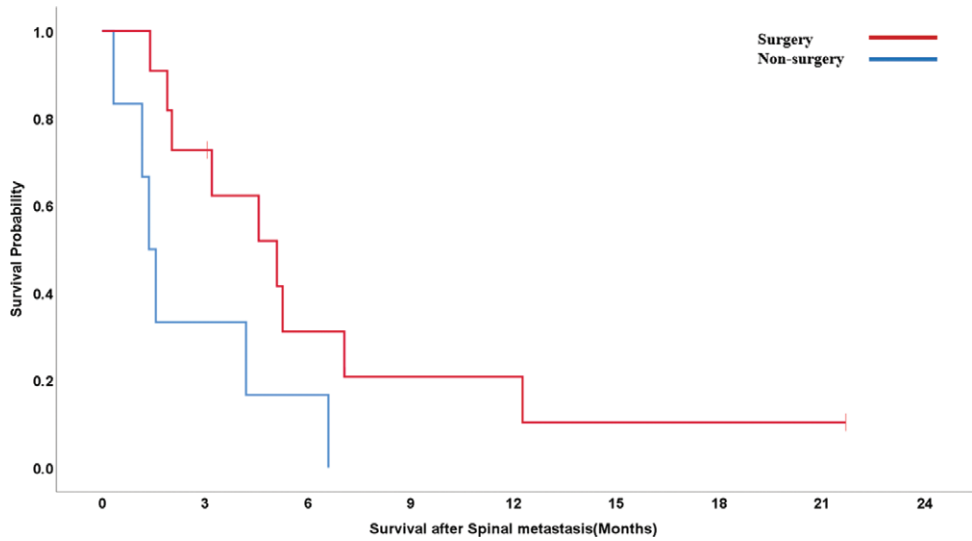

Figure 2. Kaplan–Meier curve for survival after spinal metastasis.

Table 4

Demographics of patients with paraplegia.

Case no.	Time to surgery from the clinical onset (d)	Management for spinal metastasis	Operation name (extent of resection)	Survival after spinal metastasis (mo)	Comments for general condition
2	11	Surgical treatment	Decompression T4-5 & Posterior fixation T3-4-5-6	12.27	
5	6	Surgical treatment	Decompression T3 & Posterior fixation T2-3-4-5	6.57	
16	-	Pain control & Conservative care	-	1.29	Severe sepsis with pneumonia
17	-	Pain control & Conservative care	-	4.2	Liver metastasis with Pancytopenia

Table 5

Univariate linear regression analysis of survival.

	Overall survival (mo)		Survival after spinal metastasis (mo)	
Risk factors	**Estimate (95% CI)**	***P* value**	**Estimate (95% CI)**	***P* value**
Age	−0.4 (−1.22, 0.42)	.353	−0.01 (−0.27, 0.26)	.969
Age (yr)				
<65	Ref.		Ref.	
≥65	−14.37 (−28.81, 0.07)	.07	−1.08 (−6.21, 4.04)	.684
Sex				
F	Ref.		Ref.	
M	0.68 (−15.71, 17.08)	.936	−0.1 (−5.32, 5.13)	.971
Tumor stage				
2–3	Ref.		Ref.	
4	−17.09 (−31.02, −3.15)	.03*A	−2.45 (−7.52, 2.63)	.36
Metastasis region				
1	Ref.		Ref.	
≥2	−3.35 (−19.66, 12.96)	.693	−4.13 (−8.92, 0.65)	.111
Surgery				
No	Ref.		Ref.	
Yes	−5.28 (−22.78, 12.23)	.564	4.45 (−0.72, 9.63)	.112
Paraplegia				
No	Ref.		Ref.	
Yes	−3.8 (−21.4, 13.81)	.678	0.35 (−5.29, 6)	.904
Resection of the primary tumor				
No	Ref.		Ref.	
Yes	26.7 (15.24, 38.15)	<.001*	5.65 (0.79, 10.52)	.038*
ECOG Score				
1–2	Ref.		Ref.	
3–4	−8.61 (−24.42, 7.2)	.303	−4.07 (−8.87, 0.73)	.118
ASIA classification				
2–3	Ref.		Ref.	
4–5	4.42 (−12.32, 21.16)	.612	1.78 (−3.52, 7.09)	.52
Frankel score				
2–3	Ref.		Ref.	
4–5	−0.09 (−19.12, 18.93)	.993	−0.96 (−7, 5.09)	.761
Revised Tokuhashi score				
≤4	Ref.		Ref.	
≥5	18.94 (−4.2, 42.08)	.129	10.52 (4.57, 16.46)	.003*
Tomita score				
8	Ref.		Ref.	
10	−6.51 (−25.25, 12.22)	.506	−7.94 (−12.48, −3.4)	.004*

*Statistically significant.

3.3. Comparison between surgery and non-surgery group

The comparison between the surgery and non-surgery groups is shown in Table 3. Only the change in NRS was slightly statistically significant in the surgery group when the 2 groups were compared ($P < .05$). The mean survival time after spinal metastasis in the surgical group was 6.14 ± 6.0 months, and that in the non-surgery group was 2.54 ± 2.38 months. Survival after spinal metastasis of 2 groups is shown in Figure 2. The 1-year survival rate after spinal metastasis in the operated group was 18%, with 2 patients still alive, while that in the non-surgery group was 0% ($P = .042$).

3.4. Demographics of patients with paraplegia

Table 4 shows the demographics of the 4 patients with paraplegia. Four patients had paraplegia, 2 underwent surgery and 2 underwent conservative treatment. The criteria for surgery were general conditions. Only patients in a condition capable of surgical treatment underwent surgery. The survival time of the 2 patients who underwent surgery was longer than that of the 2 patients who did not undergo surgery.

3.5. Univariate linear regression and Kaplan–Meier analysis of survival

We also performed univariate regression analysis to determine significant prognostic factors for patient survival. As described in Table 5, tumor stage and resection of primary tumor were poor prognostic factors with OS ($P < .05$). And resection of primary tumor, revised Tokuhashi, and Tomita scores were included as poor prognostic factors with SS ($P < .05$). Illustrative cases

3.6. Patient 11

When this patient's spinal metastatic pancreatic cancer was diagnosed, he was 60 years old. Three years prior, pancreatic cancer was discovered, along with liver metastasis. He underwent pylorus-preserving pancreaticoduodenectomy and liver resection. His chief complaint was severe abdominal pain with back pain at the time of spinal metastasis diagnosis. Torso-positron emission tomography scan confirmed the spinal metastasis, which was accompanied by lung, long bone, diaphragm, and rib cage metastases. Additional MRI showed massive metastasis in the lumbar/thoracic spine (Fig. 3). To relieve pain, the patient was administered total 2500 cGy of radiation to the spine by 10 fractions. Surgical management was not recommended due to multiple spinal metastases and the patient's inability to undergo surgery due to nausea, vomiting, and poor oral intake. Symptoms progressively worsened and he passed 1 month later.

3.7. Patient 5

The patient was 80 years old when first diagnosed with pancreatic cancer. Two weeks before spinal metastasis diagnosis, her initial symptoms were abdominal pain and jaundice. Two weeks later, severe back pain (NRS 7) with acute paraplegia became apparent. She presented with tingling sensation in the lower limbs, accompanied by motor weakness and hypesthesia under T3 dermatome. Spinal MRI was performed for further evaluation, and spinal metastasis was found on cervical and thoracic vertebra (Fig. 4). Spinal cord compression was also found on T3 level. Surgical intervention was necessary due to a sudden neurologic deficit. Further imaging showed a tumor mass under both sides of the T3 nerve root; therefore, decompression and fixation were performed. Her symptoms improved immediately after the surgery and palliative chemotherapy was performed.

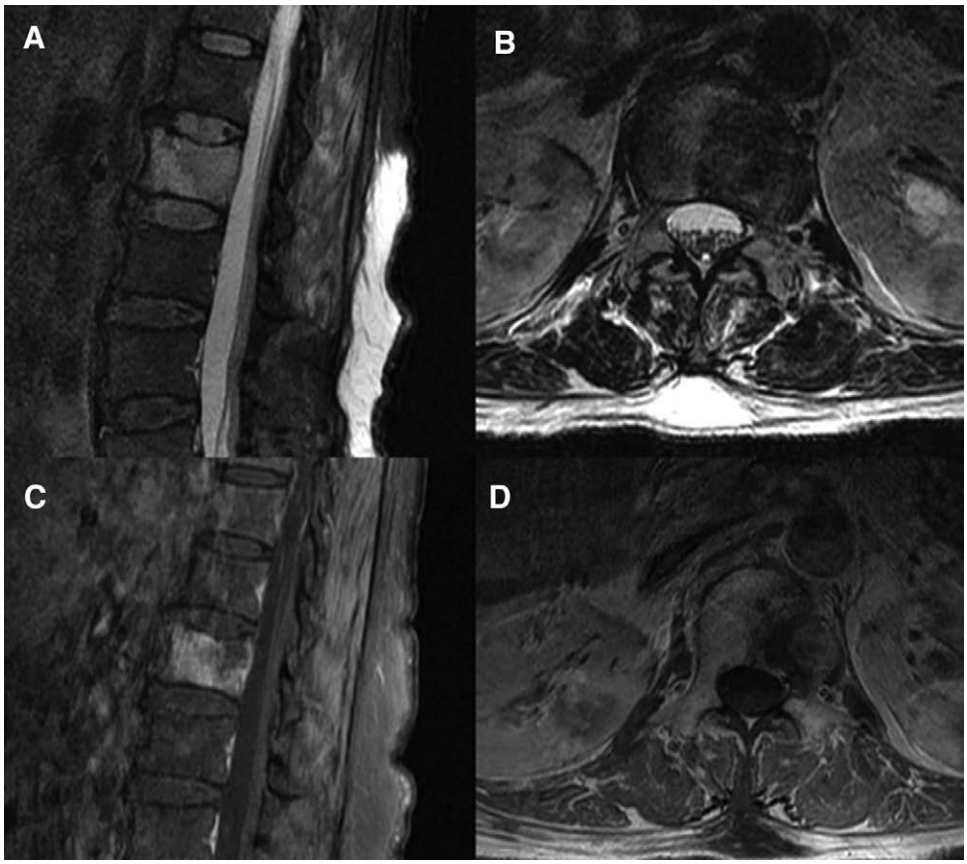

Figure 3. Pathologic compression fracture with enhancing bone marrow signal change at L1 vertebra body to left pedicle is shown. (A) T2 sagittal, (B) T2 axial, (C) T1 enhanced sagittal, and (D) T1 enhanced axial.

After 4 cycles of chemotherapy, her general weakness and poor condition worsened. She passed away 4 months later.

4. Discussion

Pancreatic cancer is a well-known malignant cancer that is difficult to diagnose in the early stages owing to lack of specific symptoms. In this study, we analyzed the characteristics of spinal metastatic pancreatic cancer cases and compared the surgery and non-surgery groups to determine whether surgical management can impact the well-being of these patient.

Most pancreatic cancer patients initially present with pain in the upper abdomen radiating to the back, malaise, weight loss, and/or jaundice.[14] Liu et al[15] reported that all patients with spine metastatic pancreatic cancer had back pain. In our study, most patients also complained of pain when spinal metastatic progression was found. Since self-ambulation and controlled pain is particularly important for quality of life,[16] managing these problems is a critical part of spinal metastatic pancreatic cancer patients' prognoses.

In our study, we discovered 7 (41%) cervical metastasis, 9 (53%) thoracic metastasis, 8 (47%) lumbar metastasis, and 2 (12%) sacral metastases. Different locations of cord compression led to different neurological deficits. Cervical metastasis and cord compression can cause upper limb weakness and neck pain, while thoracolumbar metastasis can cause low back pain, genitourinary symptoms, and lower limb weakness.[17,18]

All patients complained of severe pain, and radiologic evaluations revealed osteolytic characteristics in all patients, showing unstable spinal structure. Because all the patients had uncontrolled pain and spinal instability, surgical treatment was considered and, in some cases, found to be appropriate. Surgery primarily relieves pain and improves neurological symptoms in spinal metastases patients. Rothrock et al[19] conducted a study on spinal metastasis with a 20-year follow-up and reported that, although not statistically significant the survival rate for metastatic spinal cancer surgery improved by 1% per year. In another recent study, Xiong et al[20] reported a prospective comparison of 1-year survival in patients treated operatively and non-operatively for spinal metastasis. The surgery group showed a 25% reduction in the odds of mortality, although not statistically significant, and required a sample of over 1200 patients in total. Liu et al[15] reported percutaneous vertebroplasty as a very effective method for spinal metastatic pancreatic cancer and summarized it as follows: the surgical damage is small and the treatment effect is high; the scope of application of bone cement for spinal metastatic pancreatic cancer can be extended not only to strengthen spinal metastases, but also to the treatment of other affected bones; and (3) bone cement material can inhibit bacterial growth and tumor formation.

In our study, we considered the general condition and life expectancy of each patient; consequently, the surgical intervention group received surgery due to severe uncontrolled pain, spinal instability with collapse of vertebra structure, and acute neurologic deficit. Postoperatively, these patients achieved greater pain improvement and had higher survival rates than those of the other group. The 1-year survival rate from spinal metastasis of the operated group was 18%, with 2 patients still alive, while that of the non-surgery group was 0% (P = .042) (Fig. 2). Since many cases showed that early management of spinal metastasis may be the key to better quality of life, we concluded that surgical intervention may lead to better prognosis than non-surgical treatment if patient's general condition is fit for undergoing surgery.

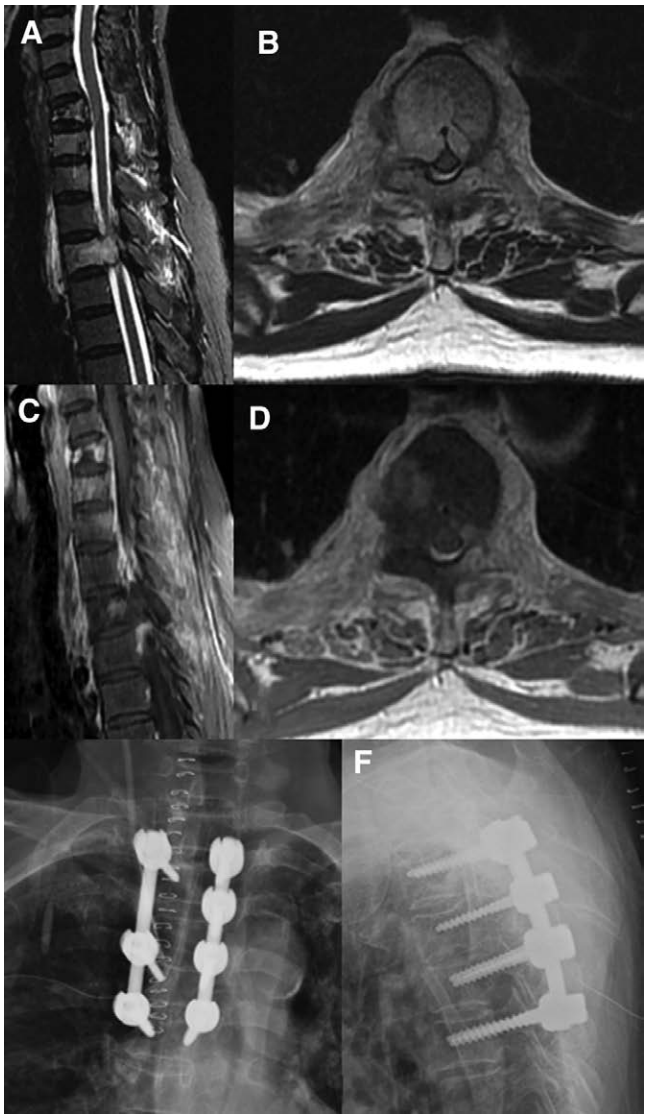

Figure 4. C6, T3 Pathologic compression fracture with T3 soft tissue bulging and compressing spinal cord. (A) T2 sagittal, (B) T2 axial, (C) T1 enhanced sagittal, (D) T1 enhanced axial, and (E and F) posterior fixation, T2–5.

We also found prognostic factors for poor spinal metastatic pancreatic cancer outcomes. Luksanapruksa et al[21] conducted a systemic literature review and meta-analysis of prognostic factors for entire spinal metastasis. They reported tumor-specific poor prognostic factors and nonspecific factors. nonspecific factors included age, systemic disease, non-ambulatory status before RT, preoperative non-ambulatory status, American Society of Anesthesiologists status, extraspinal bone metastases, number of spinal metastases, abnormal blood test, comorbidities, previous chemotherapy, primary tumor site, interval from diagnosis to spinal metastases, time developing motor deficits before RT, the interval from diagnosis to RT, preoperative neurologic deficit, severe pain, Karnofsky performance score, Eastern Cooperative Oncology Group grade, no adjuvant therapy, revised Tokuhashi score, Tomita score, gender, and visceral metastases.[21] Of these, revised Tokuhashi score was the most popular prognostic system and also showed predictive value.[21] In our study, revised Tokuhashi score, and Tomita score showed significant relations with SS ($P < .05$).

4.1. Limitations of this study

This study has several limitations. First, it was based on single-center data and comprised a small number of patients with metastatic pancreatic cancer, owing to the rarity of the disease. It was a retrospective study; therefore, some variables were not controlled. For example, treatment choice was based on each patients' symptoms and characteristics, which led to heterogeneity for each patient. Furthermore, there could be a selection bias, because patients' general condition was an important factor when deciding surgery. However, as the first paper to analyze spinal metastatic pancreatic cancer, it will help treat pancreatic cancer patients in the future.

5. Conclusion

Pancreatic cancer patients with spinal metastases showed poor prognoses and extremely short survival rates. Despite poor prognosis, appropriate surgical treatment may improve prognoses.

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