Case Report

Minimally Invasive Spinal Surgery in Spinal Metastasis Patients: A Case Series in Chulabhorn Hospital

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Background: Minimally invasive surgeryis becoming more widely used for spinal metastases because it reduces muscle injuries, blood loss and length of hospital stay, as well as post-operative complications.

Objective: The purpose of the present study is to report the outcome of minimally invasive spinal surgery by percutaneous pedicular screw fixation with and without decompression in vertebral metastasis patients.

Study design: Retrospective study.

Materials and Methods: Seventeen patients who were diagnosed with spinal metastasis underwent MIS in Chulabhorn Hospital from August 2016 to December 2018. The authors retrospectively reviewed baseline patient characteristics, perioperative and post-operative outcome, Tomita score, Modified Tokuhashi score, Visual Analog Scale Pain Score and Frankel classification.

Results: The average Tomita score was 7.05±2.16 and Modified Tokuhashi score was 8.17±2.6. The average surgical time was 196.70±97.01 minute (254±56.45 min with decompression and 90.67±53.74 min without decompression, p=0.004). The average volume of blood loss was 728±824 ml (1,059±848 ml with decompression and 123.33±233 ml without decompression, p=0.032) The survival rate was 5.87±6.03 months. The pain score decreased significantly after surgery from 9.25±0.93 to 1.56±1.75, including radiating leg pain, which decreased from 5.31±3.22 to 0.75±1.29.

Conclusion: Minimally invasive spinal surgery is a treatment option that significantly reduces pain in patients with spinal metastasis. Less blood loss and shorter operative time were observed in minimally invasive spinal surgery alone compared to the group with decompression.

Keywords: Percutaneous pedicular screw, Spinal metastasis, Minimally invasive spine surgery

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The incidence of spinal metastasis is increasing, especially in patients with breast cancer, thyroid cancer, kidney cancer, lung cancer and prostate cancer. The treatment options for spinal metastasis are chemotherapy, radiotherapy and decompressive laminectomy with spinal stabilization. In 1985, Roy-Camille et al published a surgical technique using pedicular screws, which stabilizes three spinal columns: the anterior, middle and posterior columns[1-3]. An unstable spine in spinal metastatic patients was the indication for surgery[4], which provided back pain relief and better quality of life[5]. The traditional surgical method requires an incision along the back for decompressive laminectomy and screw insertion. Therefore, minimally invasive surgery (MIS) is becoming more popular these days because the operation is less invasive. Percutaneous screws are applied in this technique along with small incisions. This improves the surgical outcomes by reducing muscle injuries, blood loss and length of hospital stay, as well as reducing complications such as wound infection. As a result, the patients can promptly get further treatment such as post-operative radiotherapy[6-8]. MIS is one of the appropriate treatment options for patients with spinal metastasis[9]. MIS iscommonly performed in several countries. At Chulabhorn Hospital, the surgical techniques have been adapted for better results. There are fewer procedures in MIS alone compared to MIS with decompression. Therefore, we also compare the difference in operative outcome between these two groups.

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Materials and Methods

Seventeen patients who were diagnosed with spinal metastasis by pathological result or magnetic resonance imaging and who underwent MIS with percutaneous pedicular screws between August 2016 and December 2018 were included in the present study. This was a retrospective study and data were reviewed by using electronic chart and results including baseline characteristics and peri-operative and post-operative outcomes. The patients were evaluated before and after surgery by Tomita Score, Modified Tokuhashi Score[10] and Visual Analog Scale Pain Score (VAS). Neurological deficits due to spinal cord compression were graded according to Frankel classification[11]; this classification defines complete motor and sensory loss as grade A, while grade E means the patient has no motor and sensory loss. The patients were followed-up at 2 weeks for wound assessment and then monthly after the surgery.

The protocol of this research was reviewed and approved by the Human Research Ethics Committee, Chulabhorn Research Institute No. 011/2562.

Surgical technique

MIS with percutaneous pedicular screw fixation was performed in all of the patients. The skin was vertically incised 2.5 cm long just lateral to the pedicle edge for screw insertion. A trocar was inserted at the pedicle entry point until the tip of trocar reached the medial pedicle wall on the true AP view. On the lateral view, the tip of trocar was needed to reach the posterior wall of the vertebral body to confirm that the medial pedicle wall was always intact. The trocar was advanced to the middle of the vertebral body. A guide wire was inserted and the trocar was removed. A cannulated pedicle screw was inserted following the direction of the guide wire and the wire was removed. The same steps were repeated for the rest of the other levels. Decompressive laminectomy was performed only in the patients with Bilsky-grade 2 and 3 epidural spinal cord compression[12,13].

Statistical analysis

Statistical analysis was carried out using matched pair comparison t-test or Chi-squared test. A p-value less than 0.05 was considered statistically significant.

Results

The average patient agewas 57.41±12.73 years. No significant difference in age was found between the patients who underwent MIS with and without decompression. The most common primary cancer was lung cancer, in 24% of patients (four cases). The second most common cancers were breast cancer (17%, three cases), cervical cancer (17%, three cases), and unknown primary cancer (17%, three cases). Other cases had prostate (6.25%, one case), renal (6.25%, one case), liver (6.25%, one case) and thyroid cancer (6.25%, one case).The prognosis was also evaluated by Tomita (average 7.05±2.16) and modified Tokuhashi (average 8.17±2.6) scores, and no significant difference was observed between the two groups (Table 1).

The neurological status of the patients was evaluated by Frankel classification. All of the patients who underwent only MIS alone classified as Frankel E, whereas the patients in the MIS with decompression group were classified as follows: Frankel A (27%, three cases), Frankel B (9%, one case), Frankel C (18%, two cases), Frankel D (9%, one case) and Frankel E (37%, four cases).

All analyzed cases are listed in Table 2. The neurological status was improved by one Frankel grade in three patients. One patient improved from grade B to C in 2 weeks, another patient from grade A to B in 1 month, and another patient from grade C to D in 1 week. No patients had neurological worsening after the surgery.

The perioperative and postoperative data are presented in Table 3. The surgery was mostly performed at thoracolumbar level (53%, 9 cases). The average number of instrumentation levels in MIS with decompression was significantly higher than MIS alone, at 5.82±1.47 and 3±1.26 levels, respectively (p=0.002). The operative time in MIS with decompression was significantly longer than MIS alone (254±56.45 and 90.67±53.74 minute, respectively) (p=0.004). The mean estimate blood loss was 728±824 ml. The volume of blood loss in MIS with decompression was much higher than the MIS with decompression group: 1,059±848 compared with 123.33±233 mL, respectively (p=0.032). The mean survival rate was 5.87±6.03 months, with no significant difference between the two groups. The overall VAS at 2 weeks was reduced immensely from 9.25±0.93 to 1.56±1.75 for back pain and from 5.31±3.22 to 0.75±1.29 for leg pain.

Discussion

Spinal metastases commonly present with pain because of vertebral collapse and instability. Stabilization by pedicular screw fixation is a standard treatment if instability occurs[14] and MIS is an option especially in spinal metastases due to benefits of less invasiveness, less complication and no requirements for fusion[15].

The mean operative time in our study was 196.70±97.01 min, which was slightly shorter than that reported in a meta-analysis by Zach et al (230.9 min)[16]. The estimated blood loss was also less than in Zach's study, at 728±824 compared with 745 mL, respectively. We found significantly more blood loss in MIS with decompression compared with MIS alone. Therefore, the advantages of MIS alone were obvious because we used only stab incisions for percutaneous screw placement and there was no open wound for the decompression site. Therefore, the blood loss and wound complications rate were reduced, which allowed early post-operative radiation therapy. Conti et al supported early radiation therapy as soon as 1 week post-operatively. This approach provides significant oncologic treatment advantages over delayed radiation at 1 month in conventional open surgery, as complete wound healing is needed[17]. The VAS was improved by 7.68 for back pain and 4.56 for leg pain; these results were comparable to that reported by Zach et al, with a 5.3 overall VAS improvement.

The authors selected the patients who had life

Table 1. Demographic and preoperative data of patients

Variable	Overall (n=17) (mean±SD)	MIS with decompression (n=11) (mean±SD)	MIS alone (n=6) (mean±SD)	p-value
Age, years	57.41±12.73	55.91±12.71	60.16±13.47	0.42
Sex, mean (%)				
Male	5 (29)	5	0	
Female	12 (71)	6	6	
Primary tumor				
Lung	4	3	1	
Breast	3	2	1	
Cervix	3	1	2	
Unknown	3	1	2	
Prostate	1	1	0	
Renal	1	1	0	
Liver	1	1	0	
Thyroid	1	1	0	
Tomita score	7.05±2.16	7.27±2.1	6.67±2.42	0.06
Tokuhashi score	8.17±2.6	7.09±2.47	10.17±1.47	0.7
Neurology				
Frankel A	3	3	0	
Frankel B	1	1	0	
Frankel C	2	2	0	
Frankel D	1	1	0	
Frankel E	10	4	6	

MIS = minimally invasive surgery

expectancy more than 3 months according to survival prognosis by Tomita and modified Tokuhashi score for palliative surgery, which may be effective in improving overall condition in long-term outcomes[18]. No significant difference in the survival prognosis assessment was found between the MIS with decompression and MIS alone groups. After the surgery, we also found no difference in survival outcomes in both groups.

There were three patients with neurological deficit who underwent urgent surgery for better neurological recovery[19,20]. The deficit was improved by 1 grade according to the Frankel grading system in all of the patients within 1 month (range 1 week to 1 month).

Our study had several limitations. Our case series had a small sample size and a lack of traditional open surgery as a control group. As a retrospective review, it can contribute to multiple biases. We also did not assess functional outcomes, such as Short Form-36 questionnaire and Oswestry Disability Index.

Conclusion

MIS is a treatment option that significantly reduces pain in patients with spinal metastasis. The outcomes of the surgery at Chulabhorn Hospital were comparable to those in previous systematic reviews. Less blood loss and shorter operative time were observed in minimally invasive spinal surgery alone compared to the group with decompression.

What is already known on this topic?

Minimally invasive surgery (MIS) is less invasive than traditional open surgery. The procedure can be used with spinal metastasis patients and has several benefits such as reducing blood loss, length of the hospital stays, early post-operative pain and wound complications.

What this study adds?

We found significantly more blood loss in MIS with decompression compared with MIS alone. The advantages of MIS alone were obvious because only stab incisions are used for percutaneous screw placement and there was no open wound for the decompression site. As a result, it reduced blood loss and wound complication rate and promoted early post-operation radiation therapy.

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Table 2. Cases included for analysis

No.	Age	Sex	Primary tumor	Frankel pre-op	Frankel last follow-up	Modified Tokuhashi score	Tomita score	Operation	Operative time (minute)	Estimate blood loss (ml)	Survival (month)
1	64	F	Cervix	B	C (improve in 2 weeks)	6	8	PDS T7-T12 DCL T10-11	170	300	4
2	56	F	Thyroid	C	C	8	7	PDST12-iliac+DCLL3-5	300	2,500	9
3	41	F	Breast	D	D	9	5	PDS T7-L3 DCL T10-11	240	400	2[1]
4	53	F	Lung	A	A	3	10	PDS T3-T11 DCL T6-7	220	1,500	2
5	30	F	Breast	A	B (improve in 1 month)	8	5	PDS T3-9 DCL T6-7	240	1,500	2
6	66	F	Unknown	E	E	7	8	PDS T10-L5+ DCL L2	360	600	1[1]
7	47	M	Lung	E	E	7	10	PDS T9-L1 DCL T11	250	400	10[1]
8	57	M	Renal	E	E	10	5	PDS T9-L2 DCL T11-12 cementation T12	300	2,300	10[1]
9	60	M	Lung	C	D (improve in 1 week)	5	7	PDS L2-S1 DCL L4	240	350	2[1]
10	74	M	Liver	A	A	4	10	PDS T11-L4+DCL L2	300	1,600	1
11	67	M	Prostate	E	E	11	5	PDS T9-L2 DCL T12	180	200	13[1]
12	63	F	Lung	E	E	9	10	PDS T9-11	35	20	6[1]
13	66	F	Cervix	E	E	10	5	PDS L1-L3	35	20	6[1]
14	51	F	Unknown	E	E	8	9	PDS L3- S1 +craig biopsy L5	100	50	1
15	64	F	Cervix	E	E	11	7	PDS T10-L2 craig biopsy L2	90	30	6[1]
16	78	F	Unknown	E	E	11	5	PDS T9-L2 craig biopsyT12	180	600	7[1]
17	39	F	Breast	E	E	12	4	PDS L3-5	104	20	25

M = male; F = female; PDS = pedicular screw; T = thoracic; L = lumbar; DCL = decompressive laminectomy
[1] patient still alive

Table 3. Perioperative and postoperative outcome

Variable	Overall (n=17) (mean±SD)	MIS with decompression (n=11) (mean±SD)	MIS alone (n=6) (mean±SD)	p-value
Level of operation, n (%)				
Thoracic	2 (11)	2	0	
Thoracolumbar	9 (53)	5	4	
Lumbar	6 (37)	4	2	
Number of operative levels	4.82±1.94	5.82±1.47	3±1.26	0.002
Operative time (min)	196.70±97.01	254.54±56.45	90.67±53.74	0.004
Estimate blood loss (ml)	728±824	1,059±848	123.33±233	0.032
Survival (month)	5.87±6.03	4±3.74	8.5±8.36	0.249
VAS back preoperative	9.25±0.93	9.30±0.95	9.17±0.98	0.77
VAS leg preoperative	5.31±3.22	7±2.52	2.67±2.25	0.01
VAS back postoperative[1]	1.56±1.75	1.1±1.85	2.33±1.36	0.0566
VAS leg postoperative[1]	0.75±1.29	1.2±1.47	0	0.091

MIS = minimally invasive surgery; VAS = visual analog pain scale score
[1] postoperative outcome at 2 weeks

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Potential conflicts of interest

The authors declare no conflict of interest.

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