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Comparative Analysis of Various Surgical Methods for Solitary Thoracolumbar Metastatic Spine Tumors

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Directed by Professor Keung Nyun Kim

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ABSTRACT

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In solitary metastatic spine tumor, treatment of choice is surgical resection. So far, various surgical methods for solitary metastatic spine tumor have been attempted with post-operative adjuvant therapy (post-operative radiation therapy). As a result, the prognosis after metastatic spine tumor surgery gets better and better. Therefore, the better patient's quality of life after surgery of metastatic spine tumor is important factor in tumor treatment. We compared and analyzed 4 surgical methods

most commonly used for solitary metastatic spine tumor. These are en bloc spondylectomy, gross total piecemeal removal, partial corpectomy and decompressive laminectomy. According to the surgical methods, the patients were divided into 4 groups (En bloc spondylectomy group: ERG, gross total piecemeal removal group: GRG, partial corpectomy group: PRG and decompressive laminectomy group: DRG). Post-operative radiation therapy was followed with all surgical methods. There were no statistically significant differences of long-term follow up visual analogue scale (VAS) and modified Japanese Orthopaedic Association (JOA) score between 3 groups (ERG, GRG and PRG). In study about amount of blood loss during operation and operation time, there were no statistically significant differences between 2 groups (ERG and GRG). However, there were statistically significant differences between PRG and the other two groups (ERG and GRG) ($P<0.05$). In recurrence rate, there were no statistically significant differences between 3 groups (ERG, GRG and PRG). In DRG, despite of post-operative radiation therapy on metastatic lesion, patients had severe pain or paralysis due to compressed spinal cord or rootlets by increased size of metastatic mass (recurrence rate: 38%). Therefore, in post-operative local control rate of 4 surgical methods, there was statistically significant difference between DRG and the other 3 groups (ERG, GRG and PRG) ($P<0.05$). Although en bloc spondylectomy has been known as the best treatment of choice for solitary

thoracolumbar metastatic spine tumors, there were no statistically significant differences in recurrence rate between ERG, GRG and PRG in this thesis. However, in partial corpectomy method, amount of blood loss during operation and operation time were significant different from these in the other two methods (En bloc spondylectomy and gross total piecemeal removal). In considering the patient's post-operative quality of life, partial corpectomy with less blood loss and shorter operation time has possibility of the best treatment of choice for solitary thoracolumbar metastatic spine tumor.

Keywords: Solitary thoracolumbar metastatic spine tumor, en bloc spondylectomy, gross total piecemeal removal, partial corpectomy, decompressive laminectomy.

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I. Introduction

According to development of medical science, the prognosis of metastatic cancer (stage IV) has been better than before.^{1,2} Various treatment methods for metastatic tumors have been developed to match the characteristics of primary cancer and

metastatic lesion.^{1, 2, 5, 7} By combining various treatment methods rather than just one, the effectiveness of treatment for metastatic spine tumor has been maximized.^{5, 17, 18} Therefore, the prognosis including patient's quality of life as well as the survival rate has been improved.^{2, 5} And the improvement of the patient's quality of life after surgery for metastatic spine lesion is considered important factor.^{2, 4, 9, 25} In solitary thoracolumbar metastatic spine tumor, treatment of choice is surgical resection. Especially en bloc removal of solitary metastatic spine tumor has been considered as the best treatment of choice for solitary metastatic spine tumor.^{8, 10, 11}

So far, various surgical methods for solitary metastatic spine tumor have been attempted.⁵ And, in addition to various surgical methods, mixed use of other various treatments (radiation therapy, chemotherapy and hormonal therapy and so on) has been tried too.⁵ As a result, in metastatic spine cancer, adjuvant radiotherapy after surgical resection has been routine course.^{1, 5} The adjuvant radiotherapy is not only to prevent recurrence of tumor but also to minimize the invasiveness of surgery.^{1, 14, 26} And such development of the post-operative management enabled development of the various surgical technique.^{1, 14} Nevertheless, in some studies, en-block spondylectomy still was considered as the best treatment of choice for metastatic spine cancer.^{10, 20, 21} However, in the other many recent studies, researchers reported some complications (massive bleeding,

longer operation time, necessary of high technique and damage to normal tissue by invasiveness) of conventional en block spondylectomy, too.^{8, 13, 19, 24} We compared and analyzed the clinical outcomes of various surgical methods that have been commonly tried for solitary metastatic spine tumor in our hospital.

II. Materials and methods

1. Materials

We conducted a retrospective study of patients with solitary metastatic spine tumor who underwent surgical treatment of a spinal lesion with a Tomita score of less than 7. From January 2002 to September 2015, ninety four patients diagnosed with solitary metastatic spine tumor were enrolled in this study. The mean follow-up period was 4.1 years (range: 2 - 11 years), and there were 64 males and 30 female (Table 1).

Table 1. Demographics of 94 patients with solitary metastatic spine tumor enrolled in this thesis.

Mean f/u period (year)	4 (2-11)
Mean age (year)	60 (34-88)
Sex	
M	64
F	30
Tumor (number)	94
Rapid growth	Lung cancer 22
	Gastric cancer 6
	Pancreatic cancer 1
	Hepatocellular cancer 19
	Nasopharyngeal cancer 2
	Bladder cancer 1
	Melanoma 1
	Lymphoma 2
	Squamous cell cancer 2
	(1:Tongue cancer)
	(1:Lip cancer)
	Primary unknown 2
Moderate growth	Renal cell cancer 13
	Colorectal cancer 5
	Uterus cancer 1
	(Endometroid carcinoma)
Slow growth	Breast cancer 10
	Thyroid cancer 2
	Prostate cancer 5
Level of spine	
	T1-7 36
	T8-12 28
	L1-5 30

Main primary tumor was lung cancer (22 cases), hepatocellular cancer (19 cases) and renal cell cancer (13 cases) (Figure 1). The metastasis of the primary tumor was evenly involved in each one spine level (Figure 2).

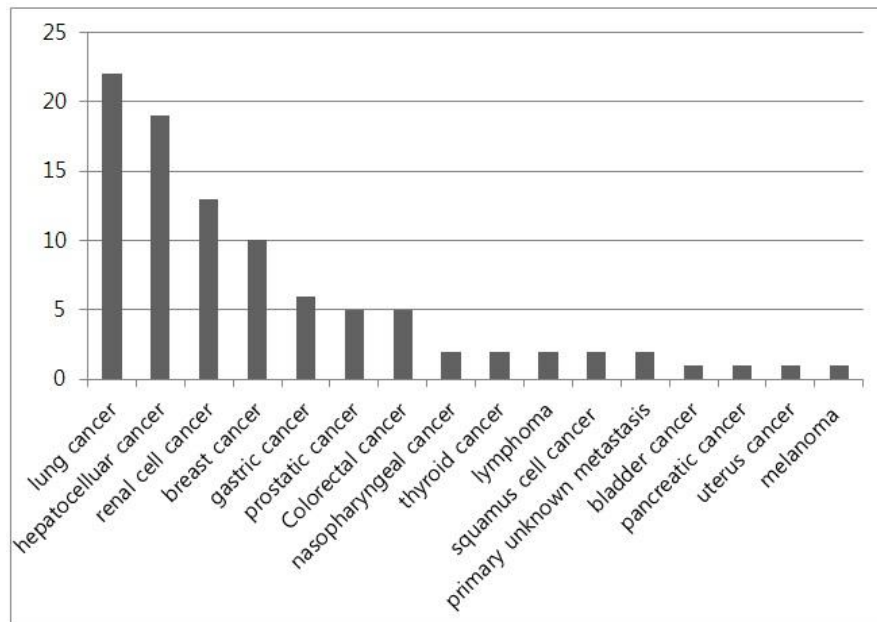


Figure 1. Primary cancer distribution in solitary metastatic spine tumor.
 In this thesis, lung cancer was most common tumor (22 cases), and second common tumor was hepatocellular cancer (19 cases). 13 cases were Renal cell cancer and 10 cases were breast cancer. And there were 2 primary unknown cases.

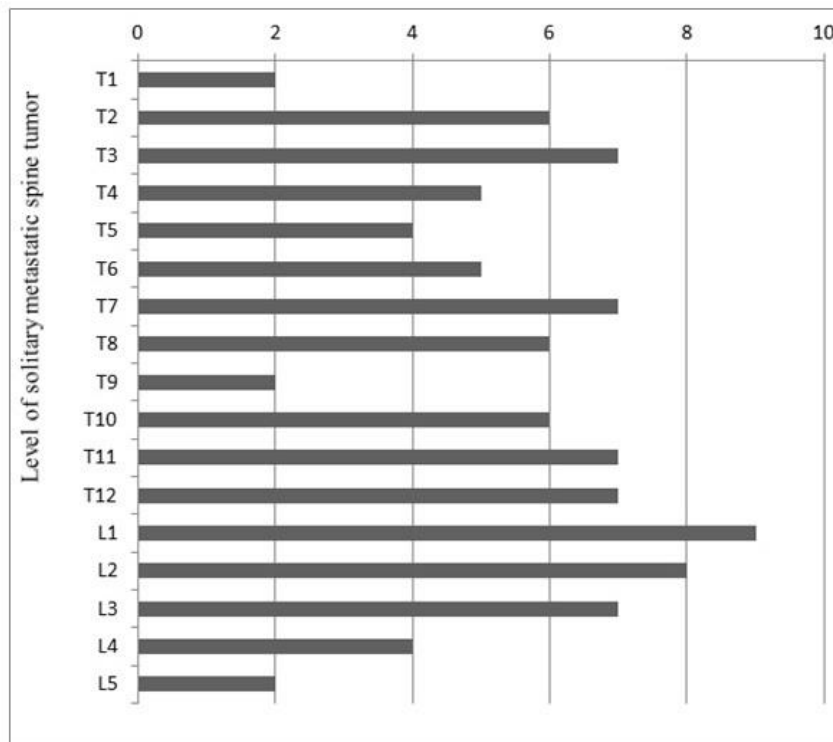


Figure 2. Level of spine distribution in solitary metastatic spine tumor.

As a single level, most common involved spine level was L1. In 36 cases, metastatic tumor was on upper thoracic level (T1-7) and in 28 cases, it was on lower thoracic level (T8-12). Lumbar level was invaded by metastatic tumor in 30 cases.

2. Methods

According to the performed surgical methods, the patients were divided into 4 groups and followed up for more than 2 years. Twenty patients underwent en bloc spondylectomy of the solitary metastatic spine lesion (called En bloc spondylectomy/resection group: ERG) and twenty six patients underwent gross total removal of the tumor (called gross total removal group: GRG). And partial corpectomy of the metastatic vertebral body was performed in twenty seven patients (called partial corpectomy/resection group: PRG). The instrumentation (cage and screw) was done in all of them in 3 groups. To compare the more accurate local effects of postoperative adjuvant radiation therapy, twenty one patients who underwent just decompressive laminectomy was enrolled in this study (called decompressive resection group: DRG). There were no instrumentations in decompressive resection group. The primary cancers were various, but all of them were limited over only single level spine. Therefore, the method of surgical resection for metastatic spine lesion was based on Tomita classification system (Figure 3).²⁰

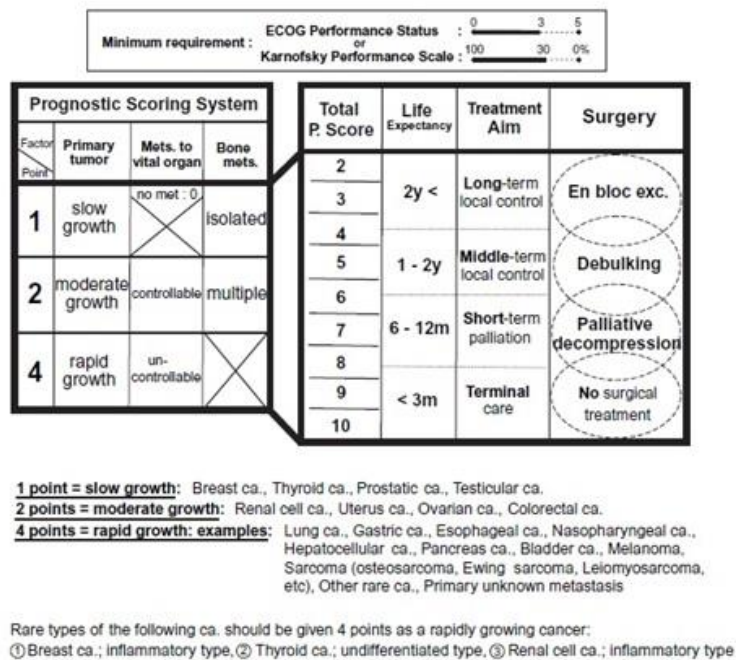


Figure 3. Tomita classification system

(Reprinted from Tomita et al. [4], according to the Creative Commons License of ELSEVIER: Tomita K, Kawahara N, Murakami H, Demura S. Total en bloc spondylectomy for spinal tumors: improvement of the technique and its associated basic background. J Orthop Sci 2006;11:3-12)

The score was less than 7 which allowed spine surgery. All of them (in 4 groups) received post-operative adjuvant radiation therapy on operated lesion. The dose of radiation was determined depending on character of primary tumor, degree of metastasis and patient's condition.

In all groups, the recurrence on the operated lesion and/or adjacent level was assessed by follow-up spine MRI, whole body bone scan (WBBS) and PET CT. Disease free survival rate, in other words, patient's survival time without recurrence of the tumor on operated and/or adjacent level was reported through Kaplan-Meier curve. To reflect the patient's quality of life according to various surgical methods, two clinical outcomes (pain and neurological change) were estimated. The pain was assessed by using the visual analogue scale (VAS), and the neurological changes were recorded by using the modified Japanese Orthopaedic Association score (modified JOA score). And we compared the amount of blood loss in operation and operation time based on anesthesia records in 3 groups (ERG, GRG and PGR) performed tumor debulking on vertebral body.

3. Statistical analysis

Data were compared statistically by using chi-square test and student t-test. And statistical significance was defined as below 0.05 of P value ($p < 0.05$.)

III. Results

1. Clinical results (VAS and modified JOA)

In 3 groups (EGR, GRG and PRG), the postoperative VAS significantly improved compared to the preoperative VAS of long-term follow-up (postoperative 6 months, 1 year, 2 years, 3 years and 4years) (Figure 1). On average, it dropped from 8.7 to 3.4 points in postoperative 2 years ($p<0.05$). However, there were no differences of postoperative VAS between 3 groups ($p=0.96$) (Figure 4).

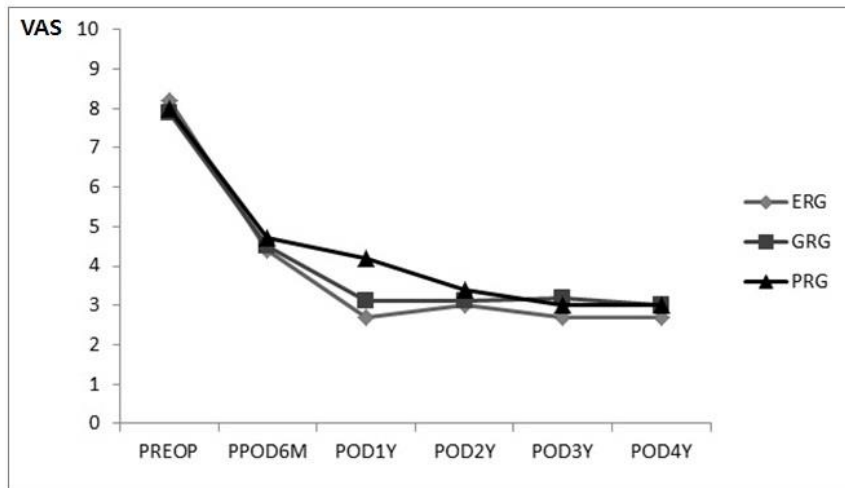


Figure 4. Visual analogue scale (VAS) in 3 groups (En bloc spondylectomy group: ERG, gross total piecemeal removal group: GRG, partial corpectomy group: PRG).

There were no differences of postoperative VAS between 3 groups (En bloc spondylectomy group: ERG, gross total piecemeal removal group: GRG, partial corpectomy group: PRG). In 3 groups, immediate post operation (until 6months after surgery) VAS were significantly improved. However, post operation 1year, there was no significant improvement in the pain score.

(PREOP: pre-operation, POD: post-operation day, M: month, Y: year)

Neurologically, postoperative modified JOA score was improved compared to the preoperative score in 3 groups too. On average, it raised from 7.1 to 9.1 in postoperative 2 years, and there was statistically difference ($p=0.03$) (Figure 5).

However, there were no significant differences of long-term follow up modified JOA score between 3groups ($p=0.91$).

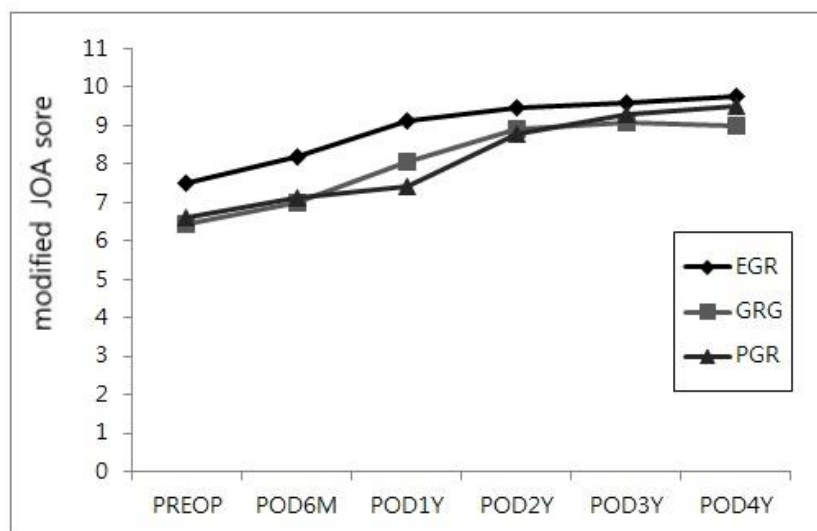


Figure 5. Modified Japanese Orthopaedic Association (JOA) score in 3 groups (En bloc spondylectomy group: EGR, gross total piecemeal removal group: GRG, partial corpectomy group: PGR, PREOP: pre-operation, POD: post-operation day, M: month, Y: year)

There were no significant differences of long-term follow up modified JOA score between 3groups (EGR, GRG and PGR).
 (PREOP: pre-operation, POD: post-operation day, M: month, Y: year)

2. Surgical results (Operation time and amount of intra operation blood loss)

In study about the amount of blood loss during operation, average amount of blood loss was 3225ml in ERG, 2170ml in GRG and 1054ml in PRG (Table 2). There was no statistically significant difference of blood loss between ERG and GRG ($p=0.23$). However there were statistically significant differences between prior two groups (ERG & GRG) and PRG ($p=0.021$). And there was no statistically significant difference of intraoperative blood loss between patient with preoperative embolization (amount of blood loss: 2845ml) and without it (2560ml) ($p=0.56$).

Table 2. Operation time and amount of intraoperative blood loss (ml) in 3 groups (En bloc spondylectomy group: ERG, gross total piecemeal removal group: GRG, partial corpectomy group: PRG, Op:operation)

	ERG	GRG	PRG
Op time (hours)	7.1	6.1	3.8
Bleeding (ml)	3225	2740	1054

In the operation time of 3 groups (ERG, GRG and PRG), EGR needed the longest operation time, on average 7.1hr. And the average operation time was 6.1hr in

GRG and 3.8hr in PRG (Table 2). There was no difference between ERG and GRG in operation time ($p=0.36$), however there was significant difference between prior two group (ERG & GRG) and PRG ($p=0.03$).

3. Recurrence rate

There was one case of recurrence on adjacent level of operation lesion in ERG. In the case of ERG, hepatocellular cancer metastasized in T12. The metastatic spine lesion had been resected through en-bloc spondylectomy to prevent local seeding of cancer cell. However post-operation 1year, recurrence of tumor was found on T11, adjacent level of prior operation T12 with distant spinal lesion T4-5 on follow up studies (WBBS and T-spine MRI). The recurrence rate of ERG was 5% (1 of 20 cases) (Figure 6). In GRG, there were 2 cases of recurrence. In two cases, recurrence of tumor was found on adjacent level of primary operation lesion by follow-up PET-CT and WBBS in post-operation 1year. The recurrence rate of GRG was 7.6% (2 of 26 cases). And in PRG, metastatic tumor regrew on partial resected site in 2 cases. The recurrence rate of PRG was 7.4% (2 of 27 cases). There were no meaningful differences of recurrence rate between 3 groups (ERG, GRG and PRG) ($p=0.24$) (Figure 6).

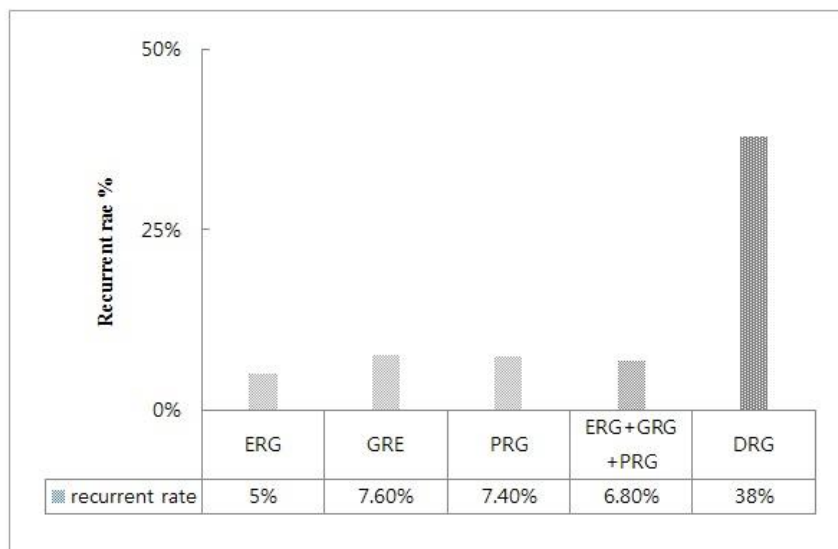


Figure 6. Comparison of recurrent rates of 4 groups at 1year following operation. There were no meaningful differences of recurrence rate between 3 groups (En bloc spondylectomy group: ERG, gross total piecemeal removal group: GRG, partial corpectomy group: PRG) ($p=0.24$).

The recurrence rate of decompressive resection group (DRG) was 38% (8 of 21 cases), and when the other 3 groups (EGR, GRG and PRG) were combined, the recurrence rate was 6.8% (5 of 73 cases). Therefore, in postoperative local control rate of 4 surgical methods, there was significant statistical difference between combined 3groups (EGR, GRG and PRG) and DRG ($p<0.05$).

In DRG, despite of postoperative radiotherapy on spine lesion, eight patients had uncontrolled severe back pain and paralysis of lower extremities due to compressed spinal nerve by increased size of tumor on prior operation spine lesion. These

symptoms were raised in postoperative 3months. The patients with these symptoms needed further treatment, reoperation, radiotherapy with increased dose and the other chemotherapy for primary tumor. The recurrence rate of DRG was 38% (8 of 21 cases), and when the other 3 groups (EGR, GRG and PRG) combined, the recurrence rate was 6.8% (5 of 73 cases). Therefore, in postoperative local control rate of 4 surgical methods, there was statistical difference between 3groups (EGR, GRG and PRG) and DRG($p<0.05$) (Figure 6).

4. Disease free survival rate

The disease free survival rate was estimated through recurrent rate. Disease free means no recurrence of tumor on operated lesion and/or adjacent level. The disease free survival rate of EGR was 100%, and those of GRG and PRG were each 100% and 98.8% in postoperative 6 months. There were no statistically significant differences between EGR, GRG, and PRG. However the rate of DRG was 66.7% (tumor recurred from 8 of 21 cases in postoperative 3months) in same time. And there was significant between prior 3 groups (average 99.6%) and DRG ($p<0.05$) (Figure 7).

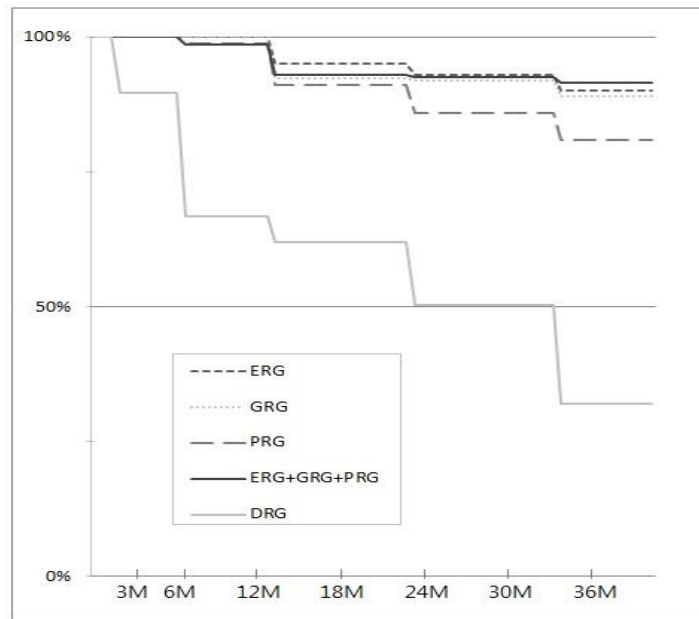


Figure 7. Disease free survival rate for 3years (Kaplan-Meier curve). (En bloc spondylectomy group: ERG, gross total piecemeal removal group: GRG, partial corpectomy group: PRG and decompressive laminectomy group: DRG, M: month)

There were no statistically significant differences between ERG, GRG, and PRG. However, the rate of DRG was 66.7% (tumor recurred from 8 of 21 cases in postoperative 3 months). And there was significant between prior 3 groups (average 99.6%) and DRG ($p < 0.05$).

In postoperative 1 year, the rates were 95% in EGR, 92.4% in GRG, 91.2% in PRG and 61.9% in DRG. Tumor recurred from 1 case in EGR and 2 cases in each GRG and PRG after surgery 1 year. There were no significant difference between ERG,

GRG and PRG in postoperative 1year, too. And there was no more recurrence in DRG after 6months and prior 3 groups after 1year, on the other hand, some patients was dead from aggravation of primary cancer and/or it's metastasis on the other site. Therefore, the disease free survival rate was significant until postoperative 1year.

IV. Discussion

The proper treatment of metastatic spine tumor is a difficult and complex process requiring consideration of multiple factors (including control of pain, stability of bone, the degree of compression of neural structures, radiosensitivity /chemosensitivity of primary cancer and the patient's condition and overall prognosis).² Because many primary tumor and metastatic spinal lesion are resistant to radiotherapy and chemotherapy, if surgery is possible, surgical resection is the best treatment of choice for these lesions.^{1, 16, 17, 25} Therefore, many spine surgeons have wanted total resection of the solitary metastatic spine tumor.^{1, 2, 3} Conventionally, treatment of choice was gross total removal of solitary metastatic spine tumor by curettage or piecemeal excision of the tumor.^{1,2, 4, 25}

Since 1989, en bloc spondylectomy has been considered as the best treatment of choice in solitary metastatic spine tumor.^{10, 20, 21} Because the en block resection could minimize local seeding of tumor cell, many spine surgeons had believed that en bloc spondylectomy of the vertebral tumor could reduce local recurrence.^{10, 11, 20, 21} Several studies have reported that en bloc spondylectomy (complete removal of the tumor with enough clean margins) was the best treatment to achieve cure or long-term local control.^{10-12, 20, 21} A study reported that after total en bloc spondylectomy of the metastatic spine lesion caused by renal cell carcinoma, there

were no local recurrence during 3 years' follow-up in 34 cases.¹¹ The other study reported that en bloc spondylectomy with good prognosis could satisfy not only surgeons but also patients and their families.¹⁰ Kato et al. examined the satisfaction level of patients and families with en bloc spondylectomy of solitary metastatic spine tumors.¹⁰ Of the 47 patients questioned, 45 were satisfied with the outcome while 2 were neutral; 54 of the 61 family members were satisfied, 5 were neutral and 2 were dissatisfied.¹⁰ The author found that dissatisfaction correlated with the patient's death less than 2 years after surgery.¹⁰

However, because the en bloc spondylectomy is defined as completely total removal of the tumor with enough margins in normal tissues, the surgical method is a highly invasive procedure.⁸ Therefore there are some possibilities of some morbidity and complications.^{12, 13, 18, 19, 24} The first possibility of morbidity is excessive bleeding.¹² Massive bleeding could make infarction on various vital organs, especially on brain or kidney.^{3, 23} Postoperative cerebral infarction or renal infarction is fatal to patients.^{3, 6} And, in en bloc spondylectomy, massive bleeding can be caused by injury to the inferior vena cava too.¹³

As this procedure needs a wide resection of tumor with normal tissue as enough margins and without violation of the tumor capsule, it could injury adjacent tissue, especially inferior vena cava.¹³ And this surgical procedure needs long operation time.¹² In some study, time of en bloc spondylectomy frequently exceeded 10

hours.¹² During long time general anesthesia, the hypotensive state is achieved by reducing peripheral vascular resistance, decreasing cardiac output, or using a combination of both.³ The major cardiovascular effect of long time anesthesia is a decrease in arterial BP owing to a drop in systemic vascular resistance, cardiac contractility, and preload.³ Finally it can causes direct myocardial depression.³

Dura tear is a common complication during spine surgery.^{21, 24} Because of invasiveness of the en bloc spondylectomy, the incidence of dura tear during of this surgical method (17.1%) is higher than during other spinal surgeries (ranges between 1.6% and 15.8%).²¹ And older age, history of RT, and revision surgery were significant independent risk factors for dura tear, too.^{20, 21} In our study, there was no difference in dura tearing between surgical methods.

For more than 25 years with many complications of the en bloc spondylectomy, many spine surgeons have recognized limitations of en bloc spondylectomy.^{8, 13, 19} And some physicians developed less invasive method of en bloc resection, 2nd generation en bloc spondylectomy (using tumor-bearing frozen autograft).⁸ However, en bloc spondylectomy still has been as the preferred method for limited patients with definite indications with many complications.²¹

Subtotal tumor resection combined with postoperative radiation has been the treatment of choice for many years too, because total tumor resection is associated with a high intraoperative morbidity due to massive bleeding, long operation time

and postoperative complications and so on.^{19, 22, 24} In our study, partial corpectomy needed less blood loss and less operation time. From the perspective of improving the patient's quality of life, partial corpectomy with postoperative radiation therapy could be good treatment of choice.² However, so far, many surgeons have worried about higher local recurrence rate of the tumor after partial corpectomy than en bloc spondylectomy.¹⁰ There were some reports about local recurrence after subtotal resection.^{10, 11} And post-operative adjuvant radiotherapy makes a second surgery difficult.¹⁰ However, secondary surgery is difficult and dangerous in recurrence of adjacent level after en bloc spondylectomy too.⁸ Some of recurrent spinal tumors are suitable for en bloc spondylectomy with extent of its applicability under strict control.¹³

In spite of surgical resection for metastatic spine tumor, if there was severe pain, radiation therapy is a well-established palliative treatment for symptomatic spine metastases.^{2, 14, 16, 26} However, although radiation therapy is the most common treatment for metastatic lesions with symptoms, a sole use of the radiation therapy for patients with progressive neurological deficits is controversial.¹⁴ Most physicians have favored surgical decompression, with radiotherapy used as an post-operative adjuvant therapy.^{2, 14} Surgical resection makes the space between dura and tumor.^{14, 25} And the distant between dura (spinal cord) and tumor makes

the possibility of higher dose radiation therapy safely.^{2, 14, 26} The inappropriate radiation therapy on epidural area (include around spinal cord) is a risk factor of dura tear (incidental durotomy) and it makes spinal cord injury, too.^{12-14, 16} Although, for long time, post-operative conventional palliative radiation therapy has been the standard treatment of metastatic spine tumor, the safety and effectiveness has been controversial too.^{14, 16} Technical improvements in radiation planning and image-guided radiotherapy have allowed for the application of stereotactic body radiotherapy to the spine.¹⁶ Spine stereotactic body radiotherapy is intended to ablate residual tumor and optimize local control by delivering several fold greater biologically effective doses. Therefore, postoperative spinal SBRT is safety and efficacy.¹⁶

Kato et al. reported massive bleeding problem by total resection of blood-rich malignant lesion (for example RCC, HCC and lung cancer).¹¹ Perioperative massive bleeding can effect to post-operative quality of life.^{10, 11} With the massive bleeding problem of total resection surgery for metastatic spine lesion, Takayoshi et al. reported some methods of preventing massive bleeding.¹⁹ They emphasized preoperative embolization, perioperative administration tranexamic acid, hypotensive anesthesia and careful homeostasis.¹⁹ Even if preoperative embolization was recommended as solution for excessive bleeding, the effectiveness of the embolization was insignificant in some cases.¹⁵ In our study,

there was no significant effectiveness, too. Maybe, amount of blood loss was determined by nature of the primary tumor itself (blood rich tumor) and surgical skill level, rather than by embolization. Tranexamic acid is a synthetic anti-fibrinolytic agent that is widely-used to reduce perioperative blood in various surgeries.⁸ In clinical surgeries, tranexamic acid reduces the requirement for blood transfusion during cardiac surgery, total knee arthroplasty, and urological surgery.⁸ Tranexamic acid could reasonably be expected to confer similar benefits in spinal surgery, too.^{8,23} While the use of tranexamic acid could theoretically increase the risk of thrombosis, no thrombotic complications have been reported to date.⁸ Intraoperative relative hypotension (systolic blood pressure 80–100 mm Hg) has become common clinical practice in most surgery.^{3,8} However, this has not been found to influence spinal cord blood circulation.³ Controlling bleeding from the epidural venous plexus and paravertebral muscle is important, too.^{3,25} For the safe and effective bleeding control from the epidural veins, some surgeons has used curved-tip bipolar forceps.³

As well as massive bleeding, transfusion, itself has a possibility of making some complications, mismatched blood, various infective disease (hepatitis and human immunodeficiency virus-HIV and so on), electrolyte imbalance (hyperkalemia) and thromboembolism and so on.^{3,6,15,23} A correlation between massive transfusion and postoperative infection in elective surgical patients has been reported.³ Furthermore,

increased recurrence rates in patients with malignant tumors have been related to immunomodulation resulting from transfusion; other consequences like multiple-organ failure and mortality have similarly been attributed to pro-inflammatory immunomodulation following transfusion.^{15, 23}

V. Conclusion

Although en bloc spondylectomy has been recognized as best treatment of choice for solitary metastatic spine tumors, in this study, there was no significant difference in recurrence rate between en bloc spondylectomy, debulking gross total removal and partial corpectomy. However, in partial corpectomy, intraoperative amount of blood loss and operation time were significantly different from the other two methods. In considering the recurrence rate on metastatic lesion, postoperative complications and the patient's quality of life, partial corpectomy with proper postoperative adjuvant therapy may be treatment of choice for solitary metastatic spine tumor.

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ABSTRACT (IN KOREAN)

흉요추부 단일마디에서 발생한 전이성 척추종양의 다양한
수술방법의 비교 분석

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의학의 발달에 힘입어 암환자들의 치료결과나 예후가 점점 좋아지고 있으며, 전이성 척추종양의 경우에도 다양한 치료 방법이 개발되고 그러한 치료방법들의 적절한 조합으로, 예전에 비해서 그 치료효과가 극대화되었으며 환자의 예후도 좋아지고 있다. 단일마디에서 발생하는 전이성 척추 종양의 경우 재발방지나 전이된 부분의 완치를 위한 치료 방법으로 전이된 추체 및 척추뼈를 단일 절편의 덩어리로 제거하는 수술방법(En-bloc Spondylectomy)이 가장 나은 방법으로 여겨져 왔다. 하지만 그러한 수술방법이 장점도 있으나 부작용이나 수술 자체의

난이도와 그에 따른 후유증 그리고 그것으로 인한 수술 예후에의 부정적 영향도 보고되고 있다. 그래서 수술 후 추가적 치료(방사선치료)에 힘입어 다른 수술방법들도 다양하게 시도되었다. 그러므로 본 연구에서는 단일마디에 전이된 전이성 척추종양의 다양한 수술방법의 결과를 비교 분석해보았다. 94 명의 흉요추부 단일마디 전이성 척추종양 진단을 받은 환자를 대상으로, 수술방법에 따라서 4 개의 군으로 나누어 각각의 임상결과를 분석하였다. 단일 절편 덩어리 전절제술을 시행한 20 명을 ERG, 추체 전절제술을 시행한 26 명을 GRG, 추체 부분절제술을 시행한 27 명을 PRG 그리고 단순 감압술만 시행한 21 명을 DRG 로 명시하고 각 군의 재발율, 종양 무재발 생존율(Disease free survival rate), 임상 결과(통증 지수 VAS, 신경학적 호전 지수 modified JOA score), 수술시간, 수술 시 출혈량을 비교 분석하였다. 단 모든 군에서는 수술 후 방사선 치료를 시행하였다. ERG, GRG 와 PRG 에서 재발율은 통계학적으로 차이가 없었으나, 다른 3 군(ERG, GRG 그리고 PRG)과 DRG 를 비교했을때는 DRG 에서 유의미하게 재발율이 높았다. (DRG 재발율 37%, $P < 0.05$). 그리고 ERG, PRG 의 종양 무재발 생존율은 수술 후 6 개월까지는 99%이상이었으며 수술

1 년후부터는 95% 였으며, DRG 는 수술 후 3 개월에 66.7% 이었으며 수술 1 년후에는 61%였다. 수술 후 통증 지수와 신경학적 변화는 각군에서 유의미한 차이가 없었다. 다만 수술시간과 수술 중 출혈량은 ERG, GRG, PRG 의 3 군과 DRG 와는 유의미한 차이가 나타났다. 결론적으로 3 가지 수술군(ERG, GRG 그리고 PRG)에서는 통증지수(VAS)와 수술 후 신경학적 호전 지수(modified JOA score), 재발율과 종양 무재발 생존율에서는 통계적으로 유의미한 차이가 없었다. 그러나 추체 부분 절제술을 시행하였을 때, 단일 절편 덩어리 전절제술이나 추체 전절제술을 시행하였을 때 보다 수술시간이나 수술 중 출혈량은 유의미하게 낮았으며 단순감압술을 시행한 경우 나머지 3 가지 수술방법에 비해서 유의미하게 재발율이 높았다. 그러므로 수술 부작용을 최소화하기 위해서, 수술 후 방사선 치료가 충분히 뒷받침이 되는 한, 추체 부분 절제술이 흉요추부 단일마디의 전이성 척추종양에서 가장 나은 치료 방법이 될 수 있다.

핵심 되는 말: 흉요추부 단일마디의 전이성 척추종양, 단일 절편 덩어리 전절제술, 추체 전절제술, 추체 부분절제술, 단순 감압술