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RESEARCH ARTICLE

A Single Centre Retrospective Analysis of Operated Intradural Spinal Tumor Cases

Opere İntradural Spinal Tümor Olguların Tek Merkezli Retrospektif Analiz Çalışması

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ABSTRACT

Objective: This study aimed to compare the outcomes of spinal intradural tumor patients treated surgically in our center with the results previously reported in the literature.

Materials and Methods: The study was approved by the ethics committee of Necmettin Erbakan University and conducted in accordance with the Declaration of Helsinki. Patient data used in the study were protected according to ethical rules and confidentiality principles. Parameters such as complaints at presentation, age, gender, neurological examination findings, tumor localization, extent of resection, histopathological diagnosis, Modified McCormick Scale (MMS), as well as operation method and complications, were evaluated. The extent of resection was analyzed in three groups as gross total resection (GTR), subtotal resection (STR) and biopsy (Bx).

Results: In the sample, 62.1% of the patients were female. The most common complaint was axial pain (41.3%). The most common neurological examination finding at the time of presentation across all patients was motor weakness (60.1%). Pathological examination of the tumors revealed meningiomas in 35 patients (42.6%), schwannomas in 17 patients (20.7%), and ependymomas in 9 patients (10.9%). Most of the identified meningiomas were localized in the thoracic region, while schwannomas were frequently localized in the lumbar region. The mean MMS was the highest (2.5) in patients with thoracally located masses. Partial or complete recovery was observed in 67% of the patients who underwent surgical treatment. The most common postoperative complication was neuropathic pain (10.9%).

Conclusion: Spinal tumor surgery is difficult and requires attention. Determining the specific tumor and its exact location is important for the reduction of mortality and morbidity in spinal tumors. Since excessive laminectomy during surgery may increase the risk of developing postoperative kyphosis, caution should be exercised. If more than two levels of laminectomy are required, stabilization may be needed to maintain sagittal balance. Early diagnosis and surgical treatment are important in patients with spinal intradural tumor.

Keywords: Spinal tumor, intradural tumor, spinal meningiomas, spinal schwannomas

ÖZET

Amaç: Bu çalışmanın amacı merkezimizde cerrahi olarak tedavi edilen spinal intradural tümör hastalarının literatür eşliğinde karşılaştırılmasıdır.

Gereç ve Yöntemler: Bu çalışma, Necmettin Erbakan Üniversitesi Etik Kurulu tarafından onaylandı ve Helsinki Bildirgesi'ne uygun olarak yürütüldü. Çalışmada kullanılan hasta verileri etik kurallara ve gizlilik ilkelerine göre korundu. Hastaların başvuru şikayetleri, yaşı, cinsiyeti, nörolojik muayene bulguları, tümör lokalizasyonu, rezeksiyon kapsamı, histopatolojik tanı, Modifiye McCormick Skalası (MMS), operasyon yöntemi ve komplikasyonu gibi parametrelerine bakıldı. Rezeksiyon kapsamı Gross total rezeksiyon (GTR), Subtotal rezeksiyon (STR) ve biyopsi (Bx) yapılan hastalar olmak üzere 3 grupta incelendi.

Bulgular: Bu çalışmada hastaların %62,1'i kadın idi. En sık görülen şikayet aksiyel ağrı (%41,3) idi. Tüm hastalar incelendiğinde başvuru anında en sık görülen nörolojik muayene bulgusu motor kuvvet kaybı idi (%60,1). Tümörlerin patolojik incelemeleri sonucunda 35 hastada (%42,6) menenjiom, 17 hastada (%20,7) schwannom, 9 hastada (%10,9) epandimom tespit edildi. Menenjiomların çoğu torakal bölgede yerleşmişken, schwannomların sıklıkla lomber bölgede yerleşim gösterdiği görüldü. Torakal yerleşimli kitlesi olan hastalarda MMS ortalaması en yüksek (2,5) olarak bulundu. Cerrahi tedavi uygulanan hastaların %67'sinde kısmen veya tam düzelme görüldü. En sık karşılaşılan postoperatif komplikasyon nöropatik ağrı (%10.9) oldu.

Sonuç: Spinal tümör cerrahisi zordur ve dikkat gerektirmektedir. Hangi tümöre ve hangi bölgeye nasıl yaklaşılacağının bilinmesi spinal tümörlerde mortalite ve morbiditenin azaltılmasında önemlidir. Cerrahideki zorluklara rağmen mikroşirürjikal tekniklerin gelişmesi, bipolar ve ultrasonik aspiratör kullanımının yaygınlaşması, peroperatif nöromonitör kullanımı ile komplikasyonsuz gross total rezeksiyon mümkündür. Cerrahi sırasında aşırı laminektomi, postoperatif kifoz gelişme riskini artırabilir; bu nedenle dikkat edilmelidir. İki seviyeden fazla laminektomi gerekiyor ise sagittal dengeyi korumak amaçlı stabilizasyon ihtiyacı doğabileceği akılda tutulmalıdır. Erken tanı ve cerrahi tedavi spinal intradural tümör hastalarında önemli yer tutmaktadır.

Anahtar Kelimeler: Spinal tümor, intradural tümor, spinal menengiom, spinal schwannom

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INTRODUCTION

Depending on their anatomical location, spinal tumors are broadly categorized into extradural (ED) (50%), intradural extramedullary (IDEM) (40%), and intradural intramedullary (IDIM) (4-10%). Spinal intradural tumors (SIDT) are rare and are mostly benign and primary tumors (1). In adults, primary spinal cord tumors are most commonly localized in IDEM (63-65%). IDEM tumors originate from meningoepithelial cells. Almost all IDEM tumors are of neuroepithelial origin (2). One of the rare causes of IDEM tumors is metastasis (3).

Although surgical resection is the mainstay of treatment for SIDTs, its indication remains debatable. The decision is usually based on neurologic findings. In this context, this study compares the presenting complaints, age, gender, neurological examination findings, tumor localization, extent of resection, histopathological diagnosis, Modified McCormick Scale (MMS), operative method, and complications of patients with SIDT treated surgically in our center.

MATERIALS AND METHODS

We retrospectively analyzed medical records of a total of 95 patients operated between 2012 and 2023 with the diagnosis of SIDT in our center. A total of 13 patients whose histopathological diagnosis could not be confirmed and whose examination and imaging records were not available were excluded from the sample. The following parameters were evaluated: complaints at presentation, age, gender, neurological examination findings, tumor localization, extent of resection, histopathological diagnosis, Modified McCormick Scale (MMS), operation method, and complications. According to the extent of resection, the following three groups were formed: (1) gross total resection (GTR); (2) subtotal resection (STR); and (3) biopsy (Bx). Gross total resection was defined as over 90% resection and below 10% residual tumor on postoperative control magnetic resonance imaging (MRI). Subtotal resection was considered as the extent of resection between GTR and Bx. Biopsy was defined as taking only a sufficiently small sample from the intradural tumor to make a diagnosis.

The results showed no difference between total and gross total resection in terms of recurrence.

Modified McCormick Scale was used to evaluate motor functions (see Table 1) (4). This scale is used to grade patients on a scale from 1 to 5 according to motor strength and sensory functions; with an increase of the deficit, the score increases.

RESULTS

Of the 82 patients with spinal tumors screened in our study, 51 were female and 31 were male. The mean age of the sample was 51.6 years in women and 56 years in men. Thoracic region was most commonly involved in women, while lumbar region was most commonly observed in men (see Table 2).

The most common presenting complaints were axial pain (41.3%), weakness (26.1%), numbness (25.6%), as well as urinary and faecal incontinence (6.7%). Depending on the level of tumor localization, patients were analyzed in the following: cervical, thoracic, thoracic 12- lumbar 1vertebral junction region, and lumbar region. According to this grouping, the most common complaints were axial pain in the cervical region, weakness in the legs in the thoracic region, pain and weakness in the legs in the T12-L1 junction region, and axial pain and pain in the legs in the lumbar region (see Table 3). The results of the analysis revealed that the most common neurological examination finding at presentation was motor weakness (60.1%), followed by sensory disturbances (58.5%) and the presence of pathological reflexes (50%). Motor impairment was observed in 80% of patients with thoracic involvement and thoraco-lumbar junction involvement. Sensory impairment was detected in all but one patient with cervical region involvement (see Table 4).

Table 1. Modified McCormick Scale

Grade	Explanation
I	Neurollogyically intact, ambulates normally, may have minimal dysesthesia
II	Mild motor or sensory deficit; patient maintains functional independence
III	Moderate deficit, limitation of function, independent with external aid
IV	Severe motor or sensory deficit, limit of function with a dependent patient
V	Paraplegic or quadriplegic, even if there is flickering movemenet

Table 2. Age and Gender Disribution By Level

		Cervical	Thoracic	T12-L1	Lumbar
Gender	Female (62,1%)	7	25	3	16
	Male (37,8%)	7	10	2	12
Age	0-18 (3,6%)	0	2	0	1
	19-35 (12,1%)	0	5	1	4
	36-50 (25,6%)	4	5	1	11
	51-65 (25,6%)	6	7	1	7
	65+ (32,9%)	4	16	2	5

Table 3. Complaints According to The Level of Tumor

		Cervical	Thoracic	T12-L1	Lumbar
Pain (41,3%)	Axial (43)	8	17	1	17
	Arm (1)	1	0	0	0
	Leg (33)	0	12	4	17
	Arm and Leg (2)	2	0	0	0
Numbness (25,6%)	Arm (4)	4	0	0	0
	Leg (40)	1	23	1	15
	Arm and Leg (5)	5	0	0	0
Urinary Incontinence (5,7%)		1	7	2	1
Faecal Incontinence (1%)		0	1	1	0
Weakness (26,1%)	Arm (6)	5	0	0	0
	Leg (38)	0	26	4	8
	Arm and Leg (6)	6	0	0	0

Table 4. Neurological Examination Findins According To Levels

		Cervical	Thoracic	T12-L1	Lumbar
Sensory Disturbances (58,5%)	Arm (5)	5	0	0	0
	Leg (36)	1	20	3	12
	Arm and Leg (7)	7	0	0	0
Numbness (25,6%)	Monoparesis (19)	7	7	1	4
	Paraparesis (25)	1	17	3	4
	Hemiparesisi (1)	0	1	0	0
	Quadriparesis (3)	2	1	0	0
	Pleji (2)	0	2	0	0
Bladder Sphincter Dysfunction (10,9%)		0	6	2	1
Anal Sphincter Dysfunction (2,4%)		0	1	1	0
Pathological Reflex (50%)	Babinski (34)	8	23	2	1
	Hoffman (7)	4	2	0	1
Deep Tendon Reflex (lower Limb)	Hyperactive (34)	9	24	0	0
	Hypoactive (19)	1	2	2	14
	Normoactive (6)	1	0	0	15
Deep Tendon Reflex (Upper Limb)	Hyperactive (5)	2	2	0	1
	Hypoactive (8)	4	1	1	2
	Normoactive (55)	2	27	4	22

Table 5. Histopathological Diagnoses and Tumor Localisation by Level

	Cervical	Thoracic	T12-L1	Lumbar
Menengioma (42,6)	11	24	0	0
Shwannoma (20,7%)	2	1	1	13
Ependymoma (10,9)	1	0	1	7
Metastatic tumors (3%)	0	2	0	1
Arachnoid Cyst (6,1%)	0	2	2	1
Meningothelial Hyperplasia (1,2%)	0	1	0	0
Cavernous Haemangioma (1,2%)	0	1	0	0
Plasmacytoma (1,2%)	0	1	0	0
B-cell NHL (1,2%)	0	1	0	0
Lipoma (1,2%)	0	1	0	0
Neurenteric Cyst (1,2%)	0	1	0	0
Mature Cystic Teratoma (1,2%)	0	0	0	1
Neurofibroma (1,2%)	0	0	0	1
Ependymal Cyst (1,2%)	0	0	0	1
Heamangioblastoma (1,2%)	0	0	0	1
Precursor B Cell Neoplasia (1,2%)	0	0	0	1
Low-Grade Glial Neoplasia (1,2%)	0	0	0	1
Atypical Lymphoid Infiltration (1,2%)	0	0	1	0
IDEM (75,6%)	12	29	4	17
IM (17%)	1	4	0	9
ID+ ED (7,3%)	1	2	0	2

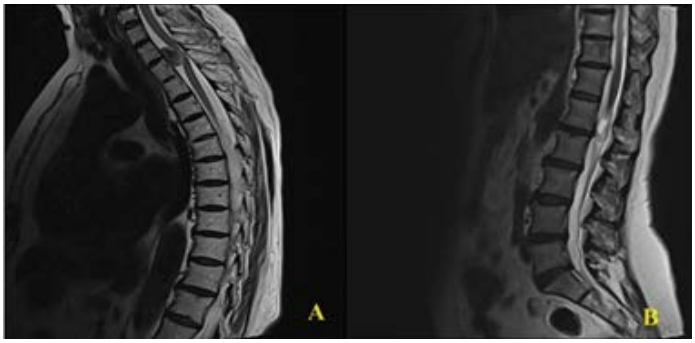

Figure 1. Histopathological Diagnoses and Tumor Localisation by Level
A. T2 sequence sagittal section magnetic resonance imaging (MRI) showing meningioma in the thoracic region
B. T2 sequence sagittal section MRI showing shwannoma in the lumbar region

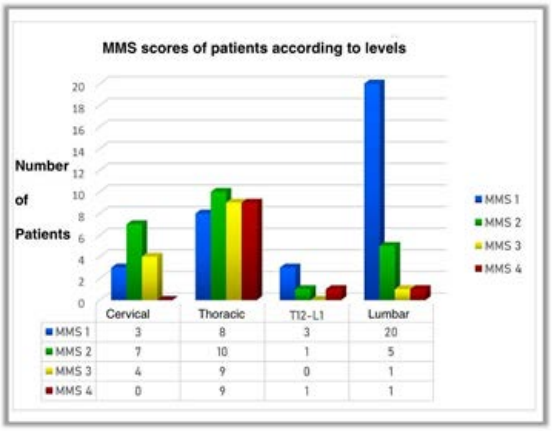

Figure 2. MMS Score of Patients According to Levels
MMS: Modified McCormick Scale

The results of our analysis of localization of the spinal tumors in the spinal canal showed that the tumor was located in IDEM in 62 patients (75.6%), IDIM in 14 patients (17%), and both intradural and extradural in 5 patients (7.3%). Pathological examination of the tumors revealed meningioma in 35 patients (42.6%), schwannoma in 17 patients (20.7%), ependymoma in 9 patients (10.9%), and arachnoid cyst in 5 patients (6.1%). Finally, metastatic tumors were detected in 3 patients (see Table 5). While most of the meningiomas were localized in the thoracic region, meningiomas were frequently found in the lumbar region (see Figure 1).

The analysis of the MMS scores of the patients at presentation according to the localization level of the tumor showed that the mean MMS score of the patients with thoracic mass (2.5) was higher than the others. In 74% of patients with lumbar masses, the mean MMS score was 1 (see Figure 2).

All patients included in the sample underwent surgical treatment. Regarding the extent of surgical resection, 62 patients underwent GTR, 18 patients underwent STR and 2 patients underwent Bx. Single level laminoplasty was performed in 13 patients, 2-level laminoplasty in 46 patients, 3-level laminoplasty in 7 patients, 4-level laminoplasty in 3 patients, single level laminectomy in 4 patients, 2-level laminectomy in 12 patients, and, finally, 3-level laminectomy in 1 patient (see Table 6).

The results of the evaluation of postoperative clinical results revealed that, according to the extent of resection, 67% of all patients showed partial/complete postoperative

Table 6. MMS Score of Patients According to Level

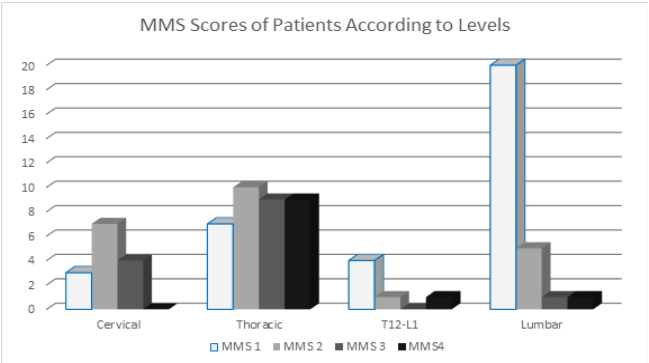

Table 8. Clinical Results According to The Extent of Resection

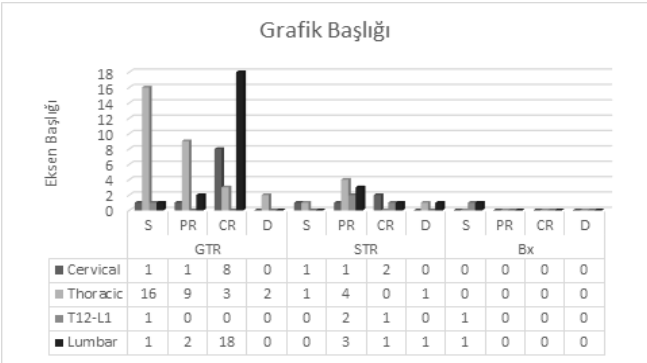

Table 7. Surgical Treatment

	Single level laminoplasty	2 level laminoplasty	3 level laminoplasty	4 level laminoplasty	Single level laminectomy	2 Level laminectomy	3 level laminectomy
Cervical	1	9	1	0	2	1	0
Thoracic	6	20	2	0	1	10	1
T12- L1	0	2	2	1	0	0	0
Lumbar	6	15	2	2	1	1	0

Table 9. Postoperative Complication

Postoperative Complication	Cervical	Thoracic	T12-L1	Lumbar
Neuropathic Pain	3	1	1	4
Wound Site Infection	0	0	0	1
Bos Fistula	0	0	0	1
Faecal-Urinary Incontinence	1	0	1	0
Pneumonia	0	1	0	0

improvement. Complete recovery (CR) was observed in 29 (46.7%) and partial recovery (PR) in 11 (17.7%) of 62 patients who underwent GTR. Of the 18 patients who underwent STR, 10 (55%) had PR and 4 (22.2%) had CR. The clinic was the same (S) in both patients who underwent biopsy. The neurological examination showed that the condition of the 2 patients who underwent GTR and 1 patient who underwent STR was deteriorated (D) in the postoperative period (see Figure 3).

Neuropathic pain developed in 9 patients (10.9%) as postoperative complication. Rarely, wound site infection was observed in 1 patient, Cerebrospinal fluid (CSF) fistula in 1 patient, faecal-urinary incontinence in 2 patients, and pneumonia in 1 patient (Table 9). Recurrence was observed in 1 (2.8%) patient with meningioma, 1 (5.9%) patient with schwannoma, and 1 (25%) patient with arachnoid cyst in the 5th postoperative year; 1 (33%) patient with metastasis in the 3rd month; 2 patients with haemangioblastoma and non-Hodgkin's lymphoma in the 1st year.

DISCUSSION

Intradural spinal tumors constitute 4% of all spinal tumors and 90% of them are extramedullary. For most part, intradural spinal tumors are benign tumors presenting clinically with mass effect rather than tissue invasion. In previous studies, the segmental distribution of spinal tumors was found to vary in different case series. In the series of Baykaner et al. (5), 56% thoracic, 24% lumbar, and 20% cervical localizations were reported. Furthermore, as reported by Temiz et al. (6), the most common localizations were thoracic and lumbar regions and both regions were found to be equal (29.78%). Total resection was achieved with microsurgery in the treatment of spinal tumors (7).

Meningiomas originate from arachnoid villi, dural fibroblasts and pia mater where the nerve root sheath meets the dura. Together, they constitute 25% of all intradural tumors. Meningiomas are more common in women than in men and are typically observed in patients aged between 40 and 50 years old. Spinal involvement is more common in children. Thoracic, cervical and lumbar regions are most commonly involved (8). The most common presenting complaint is loss of strength (92.5%), followed by sensory disturbance (60.9%), pain (53%_, and sphincter disturbance (50%). (9). Furthermore, previous neurological examination findings in spinal meningioma patients revealed that motor disorder findings were 99%, sensory disorder findings were 97% and sphincter disorder findings were 51% in Solero's meningioma series (9). Surgical treatment was applied in the treatment of cases like other spinal tumor treatments. Differently, bipolar coagulation of the dura from which the meningioma originates is recommended in the surgical treatment of meningioma because it causes less recurrence (8).

Schwannomas are benign tumors originating from the sensory branches of the cranial or spinal nerves, mostly with IDEM involvement. Unlike intracranial schwannomas, spinal schwannomas are more common in males than in females. (male/female ration = 3:1). Schwannomas are most commonly found in the thoracic region, followed by the caudal region. Schwannomas cause complaints such as radicular pain (80%) or loss of motor power and sphincter problems (10%). Since only one nerve root is frequently affected, segmental pain also occurs (10). there is evidence to suggest that the most common examination findings in patients with spinal schwannomas concerned the loss of strength (20%) and sensory deficit (16.7%) (11). Previous studies reported that ependymomas are most commonly located in the lumbar region (57%) and secondly in the cervical region (12). In children, these tumor are more commonly located in the conus (7). In Cooper's study (12), the complaints of patients with ependymoma were reported as pain, sensory disturbance, loss of strength and sphincter disturbance in order of frequency. Ependymoma is frequently centrally located. Epandimomas cause paresis in the late period. Accordingly, in patients with epandimoma, the whole spinal axis should be scanned (13).

In the present study, gender distribution of all spinal tumor patients was 3/2 (male/female) and the mean age was 53.8 years, which is consistent with the literature. Most of the identified cases were benign tumors. With regard to anatomical localization, extramedullary localization was the most common (75.6%). Both intradural and extradural localization were found in 7.3% and intramedullary localization in 17%. The most common site was thoracic region (42.6%), while the second most common site was lumbar region (34.1%). In our series, patients presented with pain (41.3%), loss of strength (26.1%), sensory disturbance (25.6%), and sphincter disturbance (6.7%), respectively. In the initial neurological examination, 60.1% of the patients reported having motor impairment, 58.5% had sensory impairment, and 13.3% had sphincter impairment. An evaluation of the MMS scores at the time of presentation showed that in the patients with thoracic mass with 2.5 points had the highest score.

In our study, meningioma was found to be the most common intradural tumor, with incidence rates exceeding those previously reported in the literature (42.6%). These cases involved thoracic and then cervical regions, respectively,

in accordance with the literature. The second most common tumor (20.7%) in our series was schwannoma. Contrary to several previous reports, schwannomas in our results were most commonly seen in the lumbar region (76.4%) and less frequently in the thoracic region (5.8%). Ependymomas involved the lumbar region were the most frequent (77.7%) in our series, which is fully aligned with the literature. Spinal tumor surgery is difficult and requires attention. Determining the specific tumor and its exact location is important to reduce mortality and morbidity in spinal tumors. Despite the difficulties in surgery, gross total resection without complications is possible with the development of microsurgical techniques, the widespread use of bipolar and ultrasonic aspirators, and the use of peroperative neuromonitoring.

However, considering the risk of postoperative kyphosis development from excessive laminectomy, surgery requires extra care. If over two levels of laminectomy are required, it stabilization may be needed to maintain sagittal balance. Lateral masses in the cervical region should be exposed and protected. In our case series, all patients underwent surgical treatment with posterior intervention (laminectomy, laminotomy, laminoplasty). Laminoplasty was performed in 78.5% of patients with cervical IDD masses, 70% of patients with thoracic IDD masses, all patients with T12-L1 localized IDD masses, and 92.6% of patients with lumbar IDD masses.
Postoperative partial or complete recovery was observed in 67% of all patients.

CONCLUSION

Spinal tumors are an important disease group in neurosurgical practice. Imaging and clinical findings should be carefully evaluated in patients to be operated for spinal tumor. Relevant surgical method(s) should be determined by considering all possible postoperative outcomes. The present study has several limitations. First, considering the retrospective nature of the present research, a bias may during data collection and analysis cannot be completely ruled out. Second, our sample consisted of 82 patients. By performing multi-center meta-analysis studies, the results of this and similar studies can be generalized to larger populations. In this study, recurrence and complications were evaluated in the 5-year postoperative follow-up of the patients. Meta-analysis studies involving more patients with longer follow-up periods in patients operated for spinal intradural tumors may reveal the complication and recurrence rates more clearly. Conducting prospective studies with larger cohorts in the future would provide a more comprehensive understanding of the outcomes of spinal tumor surgery.

DECLARATIONS

Conflict of Interest: *The authors declare no conflict of interest with respect to authorship and/or publication of this article.*

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