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Management of Lumbar Spinal Meningioma: A Systematic Review

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1. Introduction

Meningiomas are typically benign, slowly growing tumors. Meningiomas of the spine are most commonly intradural, extramedullary lesions and account of 25% – 46% of all spinal cord tumors in adults (Peker et al., 2005). Approximately 80% of spinal meningiomas occur in the thoracic spine, followed in frequency by cervical and lumbar lesions (Helseth et al., 1989; Levy et al., 1982; Roux et al., 1996; Solero et al., 1989) and little is known about lumbar spinal meningiomas. In this chapter, the outcomes of clinical studies regarding treatment of lumbar spinal meningioma are reviewed.

2. Systemic reviewing

A literature review regarding surgical treatment and clinical outcome of lumbar spinal meningioma was performed.

2.1 Search strategy

A MEDLINE database search was performed with the key words "spinal meningioma" and "lumbar." The key word "spinal meningioma" was only searched in combination. The limits included "English" for the language category, "humans" for the study category, and "added to MEDLINE in the last 10 years" for the period of publication. The date of the latest search was December 2010.

2.2 Selection criteria

Clinical papers concerning the surgical management of lumbar and lumbosacral spinal meningiomas that included treatment options and outcome analysis on follow-up were eligible for evaluation. Reference lists in articles were examined for further pertinent material. Articles were included when they contained quantitative data about the outcome and recurrence rate after surgical treatment of spinal meningiomas.

2.3 Selection and analysis of articles

Information extracted from eligible studies included the following variables: study design, patient age, gender, instrumentation, histological features, functional outcome, recurrence rate, and adjuvant therapies.

2.4 Baseline data

The MEDLINE review yielded one case series (Voulgaris et al, 2010) and nine case reports (Boet et al., 2004; Chen et al., 2004; Colen et al., 2009; Conrad et al., 2001; Epstein et al., 2005; Hirabayashi et al., 2009; Lee et al., 2002; Mizutani et al., 2002; Oviedo et al., 2005) involving 10 patients with lumbar and lumbosacral spinal meningiomas. The design was retrospective in all ten studies. Information about the age, gender, surgical approach, histological features, surgical outcome on long-term follow-up, recurrence rates, and adjuvant therapies are listed in Table 1.

Author Year	Age	Sex	Symptom	Surgical Approach	Histology	Surgical Outcome
Conrad 2001	31	F	Lumbosacral pain	Posterior	Metastatic meningioma	NA
Lee 2002	51	F	Low back pain and sciatica	Posterior – anterior - posterior	Metastatic meningioma	Significant improvement
Mizutani 2002	20	F	Low back pain and numbness	Posterior	Transitional meningioma	Significant improvement
Boet 2004	34	M	Low back pain and leg pain	Posterior	Clear cell meningioma	Significant improvement
Chen 2004	41	F	Sciatica	Posterior	Clear cell meningioma	Significant improvement
Epstein 2005	41	F	Progressive paraparesis	Posterior	Clear cell meningioma	Significant improvement
Oviedo 2005	7	M	Sciatica	NA	Clear cell meningioma	NA
Colen 2009	13	F	Low back pain and leg pain	Posterior	Clear cell meningioma	NA
Hirabayashi 2009	82	F	Leg pain	Posterior	Metaplastic meningioma	Significant improvement
Voulgaris 2010	63	F	Motor deficits	posterior	Psammomatous meningioma	NA

F: Female, M: Male, NA: not available

Table 1. Literature review of studies on lumbar spinal meningioma

Author Year	Complication	Tumor Recurrence	Adjuvant Treatment	Comment
Conrad 2001	No	Yes	Radiotherapy	Malignant meningioma
Lee 2002	No	Yes	Radiotherapy	Meningothelious meningioma
Mizutani 2002	No	No	No	Possibly induced by sex steroid pills
Boet 2004	No	No	Radiotherapy	
Chen 2004	No	No	NA	Renal transplant recipient
Epstein 2005	No	No	No	
Oviedo 2005	NA	No	No	
Colen 2009	NA	No	Radiotherapy	
Hirabayashi 2009	No	No	No	Without dural reconstruction
Voulgaris 2010	No	No	NA	

NA: not available

Table 1. (continued) Literature review of studies on lumbar spinal meningioma

2.5 Patient characteristics

The average age was 38.3 years (range, 7 – 82 years). There were two males and eight females. Patients' symptoms until surgery were low back pain and leg pain (sciatica) in 4 patients, leg pain (sciatica) in 3, neurological deficit in 2, and lumbosacral pain in 1. One patient was a very rare case of orally ingested sex hormone pills inducing meningioma (Mizutani et al., 2002), and another patient was also a rare case because she was a renal transplant recipient (Chen et al., 2004).

2.6 Surgical approach and outcome

All of the surgeries were performed via the posterior approach except in 1 case (Lee at al., 2002), in which the meningioma was present at the lumbosacral spine and was resected via the posterior-anterior-posterior approach. All cases showed significant improvement and benefit from surgery.

2.7 Tumor histology

The most common tumor histology was clear cell meningioma (5 patients), followed by metastatic meningioma (2), metaplastic meningioma (1), psammomatous meningioma (1), and transitional meningioma (1). In patients with metastatic lumbar spinal meningioma, the

tumor histology was malignant meningioma and meningotheliomatous meningioma, which was similar to that of the primary intracranial tumor in one case each.

2.8 Complications and recurrence rates

There were no incidences of intraoperative mortality or morbidity. Tumor recurrence occurred in 2 patients, in both of whom the tumor histology was metastatic meningioma.

2.9 Adjuvant treatment

Postoperative adjuvant radiotherapy was administered in 4 of 8 patients (50%). Adjuvant chemotherapy was not provided in any patients.

3. Clinics

Spinal meningiomas are usually benign, slow-growing tumors with a long clinical history until a diagnosis is made. The most common location of spinal meningiomas is the thoracic spine. The percentage of thoracic spinal meningiomas in the literature review ranged from 64% to 84%, that of cervical meningiomas from 14% to 27%, and that of lumbar meningiomas from 2% to 14% (Gezen et al., 2000; Gottfried et al., 2003; King et al., 1998; Klekamp et al., 1999; Levy et al., 1982; Namer et al., 1987; Peker et al., 2005; Roux et al., 1996; Solero et al., 1989). Clinical symptoms are typically dependent on the tumor location with respect to the spinal cord or nerve roots, the rate of tumor growth, and the extent of spinal cord and/or cauda equina compression. The most common presenting symptom in this series was low back pain and leg pain (sciatica), followed by leg pain (sciatica), neurological deficit, and lumbosacral pain. The pain is often constant, and may be described as burning or aching in quality. Pain and motor patterns may obscure a systematic clinical presentation in these patients as high cervical lesions may present as occipital headache (McCormick et al., 1990), syringomyelia, and Brown–Séquard syndrome (Parsa et al., 2004), whereas thoracic neoplasms may be disguised as visceral pathology (McCormick et al., 1990). Less commonly, motor weakness, spasticity, sensory loss (hypoesthesia, paresthesia, or anesthesia), numbness, ataxic gait, or bowel and bladder dysfunction may be the initial presentation that arouses clinical attention (Gezen et al., 2000; King et al., 1998; Klekamp et al., 1999; Traul et al., 2007; Van Goethem et al., 2004). In this series, however, numbness and/or neurological deficits were frequent symptoms in patients with lumbar spinal meningioma.

4. Epidemiology

Spinal meningiomas may affect people of all ages, but they are most commonly seen among individuals between the fifth and seventh decades of life (Albanese et al., 2002; Solero et al., 1989; Tredway et al., 2006; Traul et al., 2007). In the World Health Organization (WHO) histological classification of meningiomas, the majority of cases correspond to WHO grade I (benign biotypes). However, rare histological variants, *i.e.*, clear cell and choroid meningioma (WHO grade II) and anaplastic meningioma (WHO grade III), are predictors of significant risk of local recurrence, aggressive biological behavior, and ominous prognosis. The most prognostic variables for refractory clinical behavior are histological grade and

extent of tumor resection (Caroli et al., 2004). These tumors account for 25% – 46% of all primary intraspinal neoplasms (Peker et al., 2005). Women disproportionately (70%) harbor the intradural varieties, whereas there is a male predisposition in a small subset of spinal lesions (McCormick et al., 1990; Solero et al., 1989; Traul et al., 2007). Spinal meningiomas occur with highest frequency (80%) in the posterior, posterolateral or lateral thoracic region, followed by the anterior cervical region (15%), and infrequently in the lumbosacral region (5%) in women (Gottfried et al., 2003; McCormick et al., 1990). However, 50% of spinal meningiomas occur in the thoracic region and 40% in the cervical region in men (Van Goethem et al., 2004). Meningiomas show a greater predominance in the upper cervical region and foramen magnum than other tumors (McCormick et al., 1990). Due to their ventral or ventrolateral predisposition within the upper cervical region, spinal meningiomas may encase or surround the vertebral artery, but rarely infiltrate (Parsa et al., 2004). In the present series, most lumbar spinal meningiomas occurred in the third or fourth decade, and there was a significant difference in age between patients with clear cell meningiomas and those with another meningiomas, with the former occurring more often in younger patients. In contrast to other intradural tumors, there is a strong female predominance with a female/male ratio of 3:1 to 4:1 among patients with spinal meningiomas (Gezen et al., 2000; Gottfried et al., 2003). The female/male ratio in the present series was similar to those in previous reports.

5. Imaging

The current standard diagnostic method for spinal tumors is magnetic resonance imaging (MRI). MRI provides precise information about tumor localization (affected segment, relation to spinal cord and nerve root, and relation of the tumor to the dura), the extent of spinal cord compression, and further information about the spinal cord and the tumor itself; the presence of cord edema and intratumoral signal changes such as necrosis, hematoma, or calcification (Schroth et al., 1987). Spinal meningiomas are usually isointense to the spinal cord (T1- and T2-weighted MRI) and show enhancement after administration of contrast medium (Gd). There have been suggestions regarding the differentiation of one clinical entity from another (dural tail, broad dural contrast of meningioma, more lateral position of schwannomas, and relation to the nerve root); however, in this series, reliable differentiation between lumbar spinal clear cell meningiomas and other tumors (renal metastasis, ependymoma, neurilemmoma, and neurofibroma) by MRI was not possible (Chen et al., 2004; Epstein et al., 2005).

6. Diagnosis

The most frequent histological types among the Grade I tumors in our and the published series were the meningothelial and psammomatous types (Gezen et al., 2000; Gottfried et al., 2003; King et al., 1998; Klekamp et al., 1993; Levy et al., 1982; Namer et al., 1987; Peker et al., 2005; Roux et al., 1996; Solero et al., 1989). In Grade I meningiomas, there was no correlation between the histological subtype and patient outcome (Gezen et al., 2000; Gottfried et al., 2003; King et al., 1998; Klekamp et al., 1993; Levy et al., 1982; Namer et al., 1987; Peker et al., 2005; Roux et al., 1996; Solero et al., 1989). In this study, the most frequent histological type was clear cell meningioma. Clear cell meningioma of the spinal canal shows a tendency to occur in the lower thoracic, lumbar, or lumbosacral regions. A family history has been

reported (Heth et al., 2000; Maxwell et al., 1998). Often they are noted at surgery to have no dural attachment (Holtzman et al., 1996; Maxwell et al., 1998; Mizutani et al., 2002; Zorludemir et al., 1995). They also have a peculiar age distribution with a significant number identified in childhood (Carra et al., 2001; Dubois et al., 1998; Heth et al., 2000; Zorludemir et al., 1995). Clear cell meningiomas are sparsely reported aggressive variants with a predilection for the cauda equina. In contrast to encapsulated meningiomas, clear cell variants often afflict a younger patient population, markedly recur after gross total resection, and metastasize. They are immunohistochemically distinct and can be discriminated from other primary and clear cell tumors through positive vimentin and epithelial membrane antigen staining (Liu et al., 2005).

7. Surgical treatment

7.1 Surgical approach

Treatment of lumbar spinal meningioma is predominantly surgical. The approach should allow sufficiently wide exposure of the tumor and the dural attachment. The most frequent approach has been posterior, by laminectomy at one level or by hemilaminectomy at one or two levels with lateral extension when necessary. In our series, a posterior approach was used in all but one case in which a combined approach (posterior-anterior-posterior) was used (Lee et al., 2002). In the majority of patients, it is possible to resect even large tumors safely and without causing spinal instability using a standard posterior or posterior-lateral laminectomy approach.

7.2 Tumor resection

The primary goal of surgery is complete safe tumor removal and decompression of the spinal cord or cauda equina. The dural attachment was coagulated in most cases in the reported studies (15% – 89%), and resection of the dural attachment was performed with suturing of a patch graft in 14% – 57% of cases (Gezen et al., 2000; Gottfried et al., 2003; King et al., 1998; Klekamp et al., 1993; Levy et al., 1982; Namer et al., 1987; Peker et al., 2005; Roux et al., 1996; Solero et al., 1989). Some authors prefer to separate the outer and inner layers of the dura and resect the inner layer together with the tumor (Saito et al., 2001). In our series, there was one case report of lumbar metaplastic meningioma that was resected completely without dural reconstruction using this method (Hirabayashi et al., 2009).

7.3 Patient complications

In the reported series, morbidity and mortality rates for spinal meningiomas were low with mean values of 6.2% and 2.1%, respectively (Setzer et al., 2007). The most frequent complications included CSF leakage and wound infection, which occurred in 0% – 4% and 0% – 6% of cases, respectively (Gezen et al., 2000; Gottfried et al., 2003; King et al., 1998; Klekamp et al., 1993; Levy et al., 1982; Namer et al., 1987; Peker et al., 2005; Roux et al., 1996; Solero et al., 1989). Other less common complications were pulmonary embolism, pneumonia, and myocardial infarction. Increased surgical morbidity has been identified with resection of tumors of anterior location (Gezen et al., 2000; Roser et al., 2006; Roux et al., 1996), en plaque meningiomas (Caroli et al., 2004), clear cell meningiomas (Liu et al., 2005), and the presence of intratumoral calcifications (Roser et al., 2006; Roux et al., 1996).

Although there were 5 patients with clear cell meningioma and 1 patient with intratumoral calcification (Hirabayashi et al., 2009) in this series, there were no complications of surgery for lumbar spinal meningiomas.

7.4 Tumor recurrence

Tumor recurrence in Grade I spinal meningiomas is uncommon, with an incidence rate ranging from 0% to 14.7% in the reviewed studies (Gezen et al., 2000; Gottfried et al., 2003; King et al., 1998; Klekamp et al., 1993; Levy et al., 1982; Namer et al., 1987; Peker et al., 2005; Roux et al., 1996; Solero et al., 1989). Compared to other locations, the recurrence rate of spinal meningiomas is low (Mirimanoff et al., 1985). Very few patients with Grade II to IV spinal meningiomas were included in the reviewed studies, and thus a comparison between tumor grades and recurrence rates of spinal meningiomas was not possible. In one series, the total recurrence rate was 14.7%, which was presumably explained by the inclusion of a greater percentage of Grade II and III meningiomas (Cooper and Epstein., 1985). Tumor histology was metastatic meningioma from intracranial meningioma in 2 of 10 cases of tumor recurrence in this study.

7.5 Adjuvant therapies

Due to the good outcomes and low recurrence rates following surgical therapy, complete tumor resection is the best treatment for spinal meningiomas. In cases of subtotal resection, the efficacy of radiosurgery and stereotactic radiotherapy for intracranial meningiomas with low complication rates has been well established (Barami et al., 2007; Chang et al., 2001; Chin et al., 2003; Pollock, 2003). In this study, four of 9 patients were treated with radiotherapy. As subtotal resection will likely result in rapid tumor recurrence or progression (Prinz et al., 1996), radiotherapy may be considered in patients with subtotal lumbar spinal meningioma resection.

8. Conclusions

Due to the excellent outcome after surgery for benign lumbar spinal meningiomas together with the low complication rates, early diagnosis is required with surgery as the treatment of choice. The possibility of clear cell meningioma should be considered in young patients with lumbar or lumbosacral meningioma.

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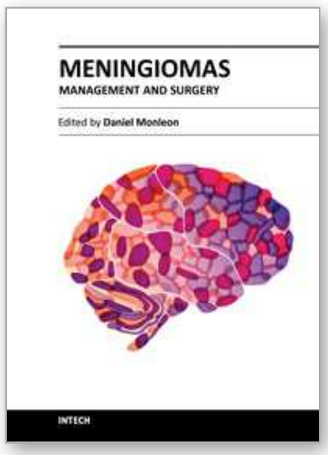

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This book is aimed at neurosurgeons with an interest in updating their knowledge on the latest state of meningiomas surgery and management. The book is focused at performing a portrait of that what is state of the art in management of meningiomas. All the chapters have been developed with high quality and including the most modern approaches for the different aspects they deal with. The book concentrates on those problems that, although perhaps less common in the day to day routine of the average neurosurgeon, when present pose a special challenge. This is neither a "how to" book nor a book about meningioma biology. It presents some of the most relevant aspects in the latest developments for meningioma surgery and management in a clear and professional manner.

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