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Spinal meningioma surgery: predictive factors of outcome

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Object. The aim of this report is to evaluate the predictive factors of poor functional outcome in spinal cord meningioma surgery.

Materials and methods. One hundred patients with spinal cord meningioma (14 men and 86 women at the age of 13–87) operated in our Neurosurgical Clinic were analyzed. Statistical data analysis evaluated the importance of symptoms, duration and neurological status before surgery and meningioma localization according to the spinal cord axis for the results of surgery.

Results. Total tumour removal was achieved in 92 and subtotal in 8 cases. In the early postoperative period, 61% of patients recovered and improved. The results of surgery reliably depended on the duration of symptoms before operation ($p = 0.05$). The risk of unimprovement prevailed in patients with paraplegia in comparison with other motor deficits. The risk of poor outcome increased with a 95% confidence index when tumour localization was ventral and caudal as compared with the dumbbell, dorsal and epidural localization taken together. Mortality was 3% after the subtotal removal of tumour, and in 3% of cases neoplasma recurred. The mean follow up was 1–22 years. The outcome at the last follow-up was good in 50% of cases.

Conclusions. Functional outcome after surgery reliably dependeds on: 1) the duration of symptoms before hospitalization (with a poor outcome when the duration of illness was more than 3 years); 2) the preoperative neurological condition of patients (a poor prognosis in paraplegic patients); 3) tumour localization with respect to the spinal cord axis (risk of unimprovement when the tumour was of ventral and caudal localization).

Key words: meningioma of spinal cord, surgery, outcome, predictive factors, late prognosis

INTRODUCTION

Meningioma is a common tumour that accounts for 25–46% of spinal neoplasms. It is generally benign, well circumscribed, and slow growing. It usually becomes clinically evident in the thoracic region and occurs most frequently in middle-aged women. Clinical symptoms depend on tumour location with respect to spinal cord and nerve roots, the rate of tumour growth and spinal cord compression. Spinal meningiomas lead to chronic spinal cord compression and myelopathy. Treatment is predominantly surgical. When the neurological status of a patient is not complicated, mostly favourable outcomes are achieved. However, progressive spinal cord compression due to spinal meningioma can lead to neurological deterioration and result in permanent deficit, even after successful surgery. Advances in radiologic and surgical techniques have brought better clinical results. In spite of these new techniques, a small percentage of patients still present with poor postoperative results and / or a recurrence. Meningioma may recur, especially as a result of incomplete resection.

In spite of the fact that there is a lot of articles about meningioma diagnosis and surgery, only few of them concern the possible predictive factors of poor outcome after surgery (1, 3, 4, 11, 12, 14). The purpose of this article is to determine the factors that influenced the outcome of surgery and late prognosis of 100 patients with spinal meningioma.

MATERIALS AND METHODS

In 1985–1998, we have treated 382 patients with spinal cord tumours, 100 (26.2%) of them with meningioma (14 men and 86 women). The mean age of males was 45 years and of females 56.5 years (range, 13–87). Patients were neurologically examined preoperatively, postoperatively at discharge, at 6 months postoperatively, and at late follow-up. The neurological examination included the scoring of sensory deficits, pain, dysesthesias, motor weakness, bladder function, and bowel function.

Neurological motor deficit was estimated by Levy (1982) classification: 0° – normal, I° – walks with aid, II° – strength more than gravity, III° – strength is less than gravity, IV° – paraplegia. We ranked radiculopathy with motor deficits.

Early postoperative results were evaluated after patients discharge from the clinic, using the history of cases and follow-up results 0.5–1 to 10–22 years after surgery (out-patients were investigated by neurosurgeons and neurologists and data were obtained from a special questionnaire). The functional outcome and neurological status were evaluated: improved, stable (no change) deterioration and death; late follow-up results were obtained from patients' investigation or a questionnaire.

Radiological diagnosis was made by X-ray, myelography with RISA J^{131}, In^{111}, positive myelography with majodyl, omnipaque, CT and MRI. Histologically, meningiomas were mostly psammous and meningothelial.

Statistical analysis. The hypothesis of the independence of analysed variables was tested with the help of crosstabulations.

Yate's correction for continuity was applied when the 2×2 table contained only small (≤ 5) frequencies. The Fisher exact test was applied for small samples. The chi-square statistics was used to test the hypothesis of homogeneity. Packaged Epinfo programs were used as the most acceptable and suitable statistical tool for data analysis.

RESULTS

The duration of symptoms before operation up to 1 year was in 41%, up to 2 years in 21%, 3 years and more in 34% (Table 1). The first symptom was pain: 2/3 of patients complained of local pain, radicular pain was defined to 1/3 patients, and paresthesia was found in 9%; changes of muscle tension were found in every third patient and pelvic function disorders in 55%. In 94% of our patients we found reflex changes, pathologic in 84% the Babinski sign, and sensory disorders in 2/3 of patients. The main presenting symptoms were pain, leg weakness and sensory disturbance.

Spinal meningiomas lead to chronic spinal cord compression and myelopathy. Table 2 shows the level of preoperative motor deficit in our patients. The complicated neurological state confirms that patients' arrival to hospital and diagnosis were late. Paraparesis and paraplegia were more frequently found in women than in men (p = 0.00l).

Meningioma prevailed in the thoracic (78%), cervical (8%) and lumbar (14%) regions. The localization of meningioma reliably (p = 0.074) depended on sex: among men, there were 21.4% cases of cervical, 21.4% of lumbar and 57.1% of thoracic localization, whereas among women only 5.9% cases of cervical, 12.8% of lumbar and 81.4% of thoracic localization were found.

The outcome of spinal cord meningioma surgery reliably depended on preoperative motor deficit (p = 0.05) and localization with respect to the spinal cord axis ((p = 0.013) (Tables 3 and 4). When a patient was operated on with motor deficit monoparesis, radiculopathy and tetraparesis, improvement was 100% (12 : 0). The results of surgery depended also on meningioma localization with respect to the spinal cord axis. Six patients with paraplegia when meningioma localization was dorsal or epidural improved and 3 showed no change. One patient with paraplegia when tumour was ventral or caudal improved, six showed no change and two deteriorated. The risk of unimprovement increases with 95% confidence index RR = 3.04(1.42–6.49) in ventral localization and RR = 4.21 (1.7–10.46) in caudal localization if compared with dumbbell, dorsal and epidural localizations taken together. The risk of poor outcome in patients with paraplegia increases (RR = 3.34, CI = 1.86–6.01) in comparison with other motor deficits. Surgery reliably depends on the duration of disease symptoms ($p < 0.05$): the probability of unimprovement in patients with the duration of symptoms more than 3 years increases (RR = 2.65, 1.37–5.12) (p = 0.003) in comparison with those with the duration of symptoms less than 3 years.

Total resection of tumour was achieved in 92 cases and subtotal in 8 cases. According to the histological structure, there were 68% of psammous, 12% of fibrous, 19% of meningothelial and 1% of osteoplastic meningiomas.

Table 1. **Distribution of 100 spinal cord meningioma patients according to the duration of illness symptoms before surgery**

Duration of symptoms, years	n
Below 0.5	9(9%)
0.5–1	32(32%)
2	21(21%)
3	10(10%)
4	9(9%)
5–10	14(14%)
>10	5(5%)

Table 2. **Distribution of 100 spinal meningioma patients according preoperative motor deficit**

Motor deficit	n	%
Radiculopathy	6	(6%)
Monoparesis	2	(2%)
Paraplegia	18	(18%)
Paraparesis	67	(67%)
Tetraplegia	3	(%)
Tetraparesis	4	(4%)

Table 3. **Results of surgery in 100 spinal meningioma patients according to preoperative motor deficit**

Motor deficit	Improved	No change	Deterioration and death	Total
	n (%)	n (%)	n (%)	n (%)
Monoparesis	2	0	0	2
Paraplegia	7	9	2	18
Paraparesis	53	9	5	67
Radiculopathy	6	0	0	6
Tetraplegia	2	0	1	3
Tetraparesis	4	0	0	4

Table 4. **Localization of 100 spinal meningiomas with respect to spinal cord axis**

Localization according to spinal cord axis	n (%)
Dorsal	18(18%)
Dorsolateral	33(33%)
Dumbbell	3(3%)
Caudal	7(7%)
Epidural	5(%)
Ventral	28(%)
Ventrolateral	6(%)

The early postoperative results: recovered 45 (45%), improved 16 (16%) of patients. Left with: monoparesis 7 (7%), paraparesis 16 (16%), paraplegia 11 (11%), tetraplegia 2 (2%), died 3 (3%). One patient with thoracic ventral meningioma localization and paraplegia died from pulmonary artery emboly 24 hours after operation. Another patient, with cervical ventral meningioma localization and tetraplegia, died 4 days after operation because of brain stem oedema and pneumonia. The third patient, with thoracic dorsal meningioma and paraplegia, died 2 days after operation from pneumonia. Postoperative complications: fistula of wound 3 (3%), purulent meningitis 2 (2%), pneumonia 1 (1%).

There were 6 recurrences – after 1, 3, 9, 10, 13 and 22 years after the first operation and subtotal tumour excision. In one case, meningioma with lumbar localization became malignant; the patient was reoperated 7 times and remained paraplegic. Good benefit at the last follow-up was found in 50% of cases.

DISCUSSION

Spinal meningioma is a benign lesion that commonly occurs in women of middle age (40–60 years) and has predilection for the thoracic spine (1–7,10, 12, 14). Our data are in agreement with data of the latter authors. Younger patients recover better than older (2, 3). Among our patients aged 31–50 only 57.1% recovered (6 of 28) and the risk to be unimproved in this group increased (RR = 2.25, 1.17–4.16), p = 0.05). A long interval between the onset of clinical symptoms and operation may also affect the outcome (4, 5). In our cases, the risk of unimprovement when the duration of symptoms was more than 3 years was RR = 2.65 (1.37–5.12, p = 0.003). The earlier the diagnosis and the better the neurological condition of a patient, the better the results (11, 13, 14). In our study group, from the onset of symptoms attended the hospital within one year 41% and within 2 years 21% of patients, so the early radiculopathy stage was found only in 6% and paraparesis in 67% of patients. The postoperative results varied according to the preoperative neurological status.

After meningioma resection, a good outcome can be expected even in the presence of complete paraplegia (4, 5, 14). Sacko et al. (4) present 32 patients aged 76 years and older, among them 20 patients with severe paraparesis and paraplegia; after operation, 30% recovered completely and the quality of life improved in the majority of cases. Haegelen et al. (5) described 33 patients, 20 of them suffered from paraparesis and 13 were paraplegic; after a one-year follow-up the neurological status of all patients improved, and 6% recovered. Advanced age does not contraindicate surgery at a severe neurological defect. There was no statistically reliable correlation between outcome and various factors such as age, gender, tumour size, the quality of tumour removal and location. Only the severity of neurological deficit and the duration of symptoms showed a correlation with the outcome (4, 5). Among our study patients, 18 were with paraplegia; after operation, 7 improved (2 could walk after 1 year), 9 showed no change, and two died. We operated on three patients with tetraplegia, of them two improved and one have died.

Peker et al. (7) and Setzer et al. (8) emphasize that spinal meningiomas are benign tumours and should be removed totally; when the neurological status is not complicated, a good outcome can be achieved (7, 8). Early diagnosis and operation is a treatment of choice. If meningioma is ventral and calcified, total removal cannot be achieved because of the of risk damaging the cord during surgery. Ventral localization of meningioma is the predictive factor of a poor outcome of surgery (8–10, 13). In our study patients, the risk of unimprovement increased (RR = 3.04, CI = 1.42–6.49) in ventral meningioma localization.

According to literature data, overall functional improvement occurs in 53–96% of cases and deterioration in 0–10% (14, 15). In Levy et al. (1982) series, the postoperative risk of increased neurologic deficit was 7%, in Solero C (1989) series 4.5% and in our group 5%, the postoperative death rate being 3%, 1.4% and 3%, respectively.

There are various rates of meningioma recurrencies after operation: King et al. (12) and Solero et al. (15) reported the recurrence rate of 8%, Levy et al. (14) 4%, Klekamp and Samii (6) 26.1 and 31.3 after a 5-year follow-up. Meningioma recurrence more is often manifested in younger patients and after subtotal tumour removal (13). Gotfried et al. (11) found that the low growth of spinal meningioma and presentation in advanced age contribute to low recurrence rates. In study, the our recurrence rate after subtotal tumour removal was 6%.

According to the literature a good outcome defined as neurologically intact or improved at the last follow-up

compared with preoperative status ranges within 85–95% (6, 7, 11, 12, 14, 15); in our cases it was 50%. In malignant meningioma cases, adjuvant therapies must be considered.

CONCLUSIONS

1. The outcome of spinal meningioma surgery depends on the duration of symptoms before operation: the prolability of poor outcome when the duration is 2–3 years increases 1.22 times and when more than 3 years 2.8 times in comparison with the duration of up to 1 year ($p < 0.05$).

2. The risk of poor outcome in patients with paraplegia increases (RR = 3.34, CI = 1.86–6.01) in comparison with other motor deficits.

3. The outcome of meningioma surgery was reliably related with localization with respect to the spinal cord axis: the risk of unimprovement increased in ventral (RR = 3.04, CI = 1.42–6.49) and (RR = 4.21, CI = 1.7–10.46) in caudal localizations in comparison with dorsal, dumbbell and epidural localizations taken together.

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CHIRURGINIS NUGAROS SMEGENŲ MENINGIOMOS GYDYMAS: BAIGTĮ PROGNOZUOJANTYS VEIKSNIAI

S a n t r a u k a

Tyrimo objektas. Įvertinti pacientų, operuotų dėl nugaros smegenų meningiomos, blogą funkcinę baigtį ir ją prognozuojančius veiksnius.

Medžiaga ir metodai. Tirta 100 pacientų (14 vyrų ir 86 moterų, amžius – 13–87 metai), sergančių nugaros smegenų meningioma ir operuotų Neurochirurgijos klinikoje. Remiantis statistikos analize, įvertinta naviko simptomatikos trukmės ir neurologinės būklės iki operacijos, taip pat meningiomos lokalizacijos nugaros smegenų ašies atžvilgiu reikšmė chirurginio gydymo rezultatams.

Rezultatai. Navikas radikaliai pašalintas 92 atvejais, iš dalies – 8. Ankstyvuoju pooperaciniu periodu pasveiko ir būklė pagerėjo 61 % ligonių. Chirurginio gydymo rezultatai priklauso nuo simptomų trukmės prieš operaciją ($p = 0,05$). Esant paraplegijai yra didžiausia tikimybė, kad paciento būklė po operacijos nepagerės, lyginant su kitais motorikos sutrikimais. Esant naviko ventralinei ir kaudalinei lokalizacijai, blogos baigties rizika padidėja 95 % patikimumo indekso, lyginant su smėlio laikrodžio dorzalinės ir epidurinės lokalizacijos navikais kartu. Pacientų mirštamumas – 3 %, po dalinio pašalinimo navikas atsinaujino 3 % atvejų. Vidutinis stebėjimo laikas 1–22 metų. Gera baigtis vėlyvuoju stebėjimo laikotarpiu sudarė 50 % atvejų.

Išvados. Funkcinė baigtis po operacijos patikimai priklauso nuo: 1) ligos simptomų trukmės iki hospitalizacijos (bloga, kai liga trunka daugiau kaip trejus metus); 2) ikioperacinės neurologinės būklės (bloga paraplegijos būklės pacientų baigtis); 3) naviko lokalizacijos nugaros smegenų ašies atžvilgiu (didesnė rizika, kad nepagerės, esant naviko ventralinei ir kaudalinei lokalizacijai).

Raktažodžiai: nugaros smegenų meningioma, chirurginis gydymas, baigtis, prognozuojantys veiksniai, vėlyvoji prognozė