Adult intramedullary astrocytomas of the spinal cord

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In this series, 25 adult patients with intramedullary astrocytomas were treated by radical excision alone. Six patients proved to have anaplastic astrocytoma; five of them died within approximately 2 years and the sixth has demonstrated disease progression. The other 19 patients were diagnosed as having low-grade astrocytoma (16 cases) or ganglioglioma (three cases); two of these had advanced preoperative neurological disability and died of medical complications. Fifteen of the remaining 17 patients have no clinical evidence of tumor recurrence after a mean follow-up period of 50.2 months; the other two have a small residual neoplasm that demonstrates no progression. Of these 17 patients, seven had previously received radiation therapy, but had clear evidence of tumor growth subsequently.

This experience suggests that surgery is not beneficial for anaplastic spinal astrocytoma. However, in cases of low-grade tumor, radical excision is associated with minimal morbidity and an excellent long-term prognosis when carried out before significant disability occurs.

KEY WORDS • spinal neoplasm • astrocytoma • surgical approach • outcome • radiation therapy

S P I N A L cord tumors are generally considered to occur about 10% as frequently as intracranial neoplasms. 14,16,17 Only 30% of such tumors are intramedullary, 16 and in adults the majority of these are ependymomas. 14,16,17 Thus, an intramedullary astrocytoma of the spinal cord in the adult patient is a fairly uncommon entity. The rarity of the condition and its indolent clinical evolution have made the evaluation of treatment efficacy quite difficult. 2,10-12,16

The traditional treatment of intramedullary astrocytoma has been biopsy followed by radiation therapy, 12 this was based on the concept that spinal cord astrocytomas, like cerebral astrocytomas, were infiltrative in nature. 3,8,11 The efficacy of this treatment is currently controversial, with some authors 3,4,12,15 reporting long-term control of ependymomas and, to a lesser degree, of astrocytomas, while others 16,11 believe that the role of radiotherapy requires substantiation since the existing series are small and few in number.

The perceived inadequacy of this traditional treatment together with recent microsurgical advances have led many to take a more aggressive approach. This was first attempted with ependymomas, which have been noted by several authors to represent a surgical entity. 4,8,11,13,15 A similar radical surgical approach to 186 intramedullary spinal cord tumors occurring in children was utilized between 1982 and 1990 by the senior author (F.J.E.). Of 100 children followed for a mean of 5 years, the overall survival rate was 95%, with 80% having a disease-free interval. 6 Of these tumors, 90% were benign and either low-grade astrocytomas or gangliogliomas. During that time, the same operation was performed on 25 patients over the age of 18 years, allowing assessment of the surgical efficacy in this older group. Intramedullary tumors other than astrocytomas were excluded from the study.

Clinical Material and Methods

Patient Population

Twenty-five adult patients with spinal cord astrocytomas underwent gross total resection of the tumor by the senior author (F.J.E.). There were 13 men between 17 and 62 years of age (mean 30.2 years) and 12 women between 19 and 61 years of age (mean 29.6 years).

Clinical Evaluation

Prior to 1986, preoperative radiological evaluation consisted of myelography and immediate and delayed metrizamide computerized tomography. Twelve patients were studied in this way. The remaining 13 were evaluated by magnetic resonance (MR) imaging alone, and follow-up examination was performed similarly (Fig. 1).
Case records were examined for presenting symptoms, duration of illness prior to diagnosis, and preoperative, postoperative, and late follow-up functional status. A patient’s functional status was classified according to the system described by McCormick, et al., as follows: Grade I, neurologically normal, with a mild focal deficit not significantly affecting the function of the involved limb, mild spasticity or reflex abnormality, and normal gait; Grade II, the presence of a sensorimotor deficit affecting the function of the involved limb, mild to moderate gait difficulty, and severe pain or dysesthetic syndrome impairing the patient’s quality of life, but with independent function and ambulation; Grade III, more severe neurological deficit, the requirement of a cane or brace for ambulation, or significant bilateral upper extremity impairment, with or without independent function; and Grade IV, a severe neurological deficit, the requirement of a wheelchair or cane or brace due to bilateral upper extremity impairment, and usually without independence of function.

The location and grade of the tumor were ascertained from radiological and pathological records, and the patients were classified into two groups; those with a low-grade tumor (Group A) and those with an anaplastic lesion (Group B). There were 10 men and nine women in Group A (Table 1). Their ages at surgery ranged from 17 to 62 years (mean 33.3 years). The most common presenting symptoms were pain (nine cases) and sensory deficit (seven cases), with significant weakness usually evolving much later. Pain was predominantly along the spinal axis. The duration of symptoms prior to diagnosis was available for 18 patients and ranged from 2 weeks to 72 months. Histopathology disclosed 16 low-grade astrocytomas and three gangliogliomas.

There were three men and three women in Group B, all with astrocytoma grade IV (malignant) tumors (Table 1). Their ages ranged from 20 to 38 years (mean 31 years). The most common presenting symptom was pain along the spinal axis (five of six cases), with a short duration of symptoms (3 to 5 months). Additional symptoms evolved rapidly so that, by the time of surgery, the patients were quite disabled.

**Surgical Approach**

All patients underwent gross total excision of the tumor (Fig. 2). Intraoperative ultrasonography was employed before and after resection to assure complete removal of the neoplasm. Other surgical adjuncts included evoked potential monitoring, the laser, and excision by means of the Cavitron ultrasonic surgical aspirator. No Group A patient was treated with radiotherapy following surgery, although seven of the 17 survivors without tumor recurrence had previously undergone radiation therapy (see below).

**Follow-Up Study**

Among patients with low-grade tumors (Group A) who did not die of complications, the follow-up period varied from 16 to 89 months. Among those with a ma-
Intramedullary spinal cord astrocytomas

![Image]

**FIG. 2.** Intraoperative photographs of a patient with spinal cord astrocytoma. *Upper:* Photograph prior to pial incision showing spinal cord swelling. *Center:* Photograph after incision of the pia demonstrating the tumor bulging through the myelotomy. Note the clear interface between the tumor (closed arrows) and the spinal cord (open arrows) at the rostral extent of the myelotomy. *Lower:* Photograph following radical resection showing the white interface at the anterior extent of the tumor resection (open arrows).

Malignant lesion (Group B), the follow-up study ranged in duration from 4 to 12 months.

**Results**

**Mortality Rates**

Of the 19 patients in Group A, two have died. One patient, a 19-year-old man, succumbed to a pulmonary embolus 2 months after surgery; the other, a 59-year-old woman who was quadriplegic preoperatively, died of medical complications 27 months postoperatively. The remaining 17 patients have survived for a mean of 50.2 months. Of these patients, seven had undergone biopsy or subtotal removal and radiation therapy from 1 to 7 years earlier. However, radiological and clinical deterioration documented tumor progression from a few months to 4 years after initial treatment.

Of the six patients in Group B, five have died between 4 and 23 months postoperatively from tumor progression or dissemination. The sixth was operated on 8 months ago and is still alive but demonstrates disease progression.

**Complications**

Twelve of the 17 survivors of Group A were fully functional (Grades I and II) with a mean follow-up period of 50.2 months; five were severely disabled (Grades III and IV). Comparing the functional status at follow-up examination with the preoperative grade, 12 patients were unchanged, three were improved, and two were worse. As noted before, two died of complications (Table 2).

In Group B, the functional status of four patients declined as a result of surgery, and two who were already wheelchair-bound remained unchanged. As noted above, five of the six died within short follow-up periods.

**Follow-Up MR Imaging**

Radiological investigation after surgery showed that 15 of the 17 Group A survivors have no evidence of residual tumor on MR imaging, and two have a small volume of neoplasm that has demonstrated no progression over the follow-up period.

**Discussion**

**Radical Resection**

Gross total removal of the low-grade spinal cord astrocytomas in this series was associated with preservation of satisfactory neurological function for the entire follow-up period. Patients in Group A tolerated the surgical procedure with little morbidity and have had no evidence of tumor progression either clinically or

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**TABLE 2**

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* Functional status classified according to the system described by McCormick, et al.†

† Group A patients presented with low-grade tumors; Group B with anaplastic lesions.
radiologically. It is important to point out that every patient who had previously undergone biopsy or subtotal removal with radiation therapy subsequently experienced tumor progression. The biology of astrocytoma is, of course, unpredictable, and no one can foretell the outcome a few years from now; however, the present evidence shows very clearly that, prior to radical excision, there was tumor progression and, since the procedure, there has been none (Figs. 1 and 2).

**Normal Neurons in Tumor Specimen**

It has been pointed out in a previous report that occasional non-neoplastic neurons are identified on pathological examinations of low-grade astrocytomas. The inference is that, at least in the adult, these are really infiltrating tumors, and that morbidity will be associated with radical excision. We have also observed these neurons in many of the tumor specimens in our series. However, even a benign astrocytoma has some capacity to infiltrate adjacent neural tissue. It is probably a complete impossibility to perform gross total removal without at least microscopic disruption of nearby cells and, therefore, occasional normal neurons mixed with the neoplastic tissue are to be expected. We must point out that, in our experience, these findings were not associated with morbidity or long-term neurological dysfunction.

**Radiation Therapy**

What we have learned from working with previously irradiated patients leaves the indication for radiation therapy for the management of intramedullary astrocytomas considerably in doubt. The present series suggests that the majority of spinal cord astrocytomas, even in adults, consist of low-grade tumors associated with prolonged evolution. Radiation therapy is known to work best on rapidly dividing cells, so that, at least on theoretical grounds, it should have little effect on slowly dividing benign lesions. This report deals with a relatively long follow-up study for a fairly small series of tumors. Only the efficacy of surgical treatment was assessed; however, disease progression in previously irradiated patients was clearly demonstrated, whereas none was found after radical surgery, whether or not radiation had been administered previously. It should be noted that there was no significant difference in the length of follow-up study between previously irradiated and nonirradiated patients.

**Unchanged Pathology**

It is of interest that in the seven patients who underwent previous therapy, the microscopic pathology had not changed between one procedure and the other. We had been concerned that malignant degeneration of adult astrocytoma might be a common phenomenon, but this did not occur in any patient.

**Timing of Surgery**

It is essential that surgery be performed before significant neurological deterioration occurs. Of the seven patients previously treated with biopsy or subtotal resection and radiotherapy, only two were at a functional level (Grade II) before radical resection. After surgery, one of these patients experienced early deterioration followed by a stable functional status, and one had early deterioration followed by improvement in functional status. The other five patients remain significantly disabled.

Of the Group A patients not previously treated, the majority have had stable postoperative function compared with their preoperative status. A small minority improved, and an even smaller minority deteriorated. The important point to be noted is that the better the functional grade before surgery, the greater the likelihood of a successful return of function afterward.

**Radical Resection for Anaplastic Astrocytomas**

We no longer propose "radical" surgery in patients with anaplastic spinal astrocytoma (Group B in our series) because they are not likely to improve and are at risk of becoming worse. It also be remembered that malignant tumors are more common in adults than in children. In this series, six (24%) of 25 adults had anaplastic astrocytomas; however, among 100 children under 19 years of age with spinal astrocytoma, we have encountered only 10 such cases (10%). Because of this, the overall surgical outlook for adults is considerably poorer than for the pediatric population.

**Conclusions**

Our experience demonstrates that a low-grade astrocytoma is a biologically indolent neoplasm in adults, as it is in children. Radical excision is associated with minimal morbidity and an excellent long-term prognosis when carried out before there is significant disability. If gross total resection is achieved, adjunctive radiotherapy appears to be unnecessary.

**References**

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