Resection of myxopapillary ependymomas in children

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Object. Currently, the optimal treatment of children harboring myxopapillary ependymomas of the spinal cord remains somewhat debatable. The authors present a retrospective study in which they evaluated the records of patients in whom resection of these lesions had been performed.

Methods. Fourteen pediatric patients who had undergone resection of a spinal cord tumor between September 1982 and July 2004 were identified from the database as having histologically classified myxopapillary ependymomas. There were 10 boys and four girls ranging in age from 7 to 18 years (mean age 12.6 years): 71% of the patients were boys. The clinical presentation of the tumor’s course was slow and indolent, and the patients had a mean symptom duration of 19.6 months. Twelve patients, who underwent a total of 16 operations, were available for long-term follow-up review. Thirteen gross-total resections and three subtotal resections were performed. There were no deaths due to surgery. Postoperatively, patients initially remained at their preoperative level of function or improved. Patients who had undergone previous surgery and radiotherapy were treated more conservatively than patients who were undergoing surgery for the first time. Four children experienced significant complications following treatment.

Conclusions. As the authors demonstrate in this study, excellent outcomes may be obtained with the use of aggressive surgical techniques with the goal being that of gross-total resection. Despite the best of resections, however, the risk of recurrence remains. Therefore, periodic neuroimaging surveillance of the neuraxis and close clinical follow up are warranted throughout the patient’s life. The role for adjunctive chemo- and radiotherapy remains to be defined in the management of myxopapillary ependymomas.

Key Words • myxopapillary ependymoma • intradural • spine tumor • ependymoma • pediatric neurosurgery

Myxopapillary ependymomas are a distinct variant of spinal ependymomas. They occur most commonly in the lumbosacral region and originate from within the terminal filum or the conus medullaris. They account for 13% of all spinal ependymomas and as many as 90% of all tumors in the conus medullaris.5,6 These tumors appear to be rare in the pediatric population, and only a limited number of pediatric cases have been published. The majority of patients are male and present in their third or fourth decade of life. The tumors vary greatly in size and typically have a long prodrome. Myxopapillary ependymomas frequently cause nonspecific symptoms such as nighttime back and leg pain, which may be misinterpreted as radicular pain caused by degenerative disease. Motor, sensory, urinary, and gait abnormalities can also develop.

In 1932 the ependymoma subgroup of the myxopapillary variant was first recognized by Kernohan as a separate histological entity. He described areas of mucinous degeneration within the vascular connective tissue cores of papillary tumors. In the World Health Organization classification of central nervous system tumors, myxopapillary ependymomas are categorized as Grade I lesions.6,8,13 Although myxopapillary ependymomas are considered benign with a tendency for slow growth and local recurrence, especially after incomplete resection, they are capable of leptomeningeal dissemination and rarely even of extraneural metastasis.5,6,22,24 It has been reported that children are more likely to experience metastases and a more aggressive disease course.8,10,42

In this report, we retrospectively reviewed a series of 14 children with myxopapillary ependymomas. The patient characteristics, clinical presentation, surgical findings, and long-term outcome are discussed. The relevant literature concerning myxopapillary ependymomas in children is also reviewed.

Clinical Material and Methods

We conducted a retrospective review of the spinal tumor database at The Johns Hopkins University School of Medicine. Between 1982 and 2004, 14 children with histologically verified myxopapillary ependymomas were identified as having undergone surgery for spinal tumors. All data were obtained from chart review. Follow-up information was obtained by telephone contact with the families and/or the pa-
tients’ current physicians. Epidemiological coordinates were noted. Clinical information was recorded and included the duration of symptoms, symptoms and signs at the time of presentation and surgery, and number and nature (surgical or adjunctive) of prior treatment(s). The histopathological diagnosis was established at the time of treatment and was not reviewed for the purpose of this analysis.

The imaging findings were recorded and compared with findings at surgery (Table 1). At surgery, usually the strategy was to achieve a resection as radical as safely possible. All patients underwent a laminotomy or laminectomy to expose the entire tumor. The complete exposure was confirmed by intraoperative ultrasonography before opening the dura mater. An attempt was made at en bloc removal of the tumor, with the intention of preventing future tumor seeding. If this was not possible because the tumor had already disseminated along the nerve roots, the tumor was internally debulked and removed piecemeal with the aid of surgical instruments such as bipolar coagulation with suction, the Cavitron Ultrasonic Surgical Aspirator (Cooper Medical), or a microsurgical laser. As much of the tumor capsule as safely possible was removed. For the majority of the second operations the tumor was removed in this fashion. Since the early 1990s intraoperative neurophysiological monitoring and nerve root mapping have been used to minimize the risk of neurological injury.31,32

Based on preoperative imaging and intraoperative findings the tumors were categorized as circumscribed or disseminated. Preoperative evidence of disease separate from the primary tumor site was regarded as dissemination regardless of the configuration of the primary tumor.

The postoperative oncological outcome was characterized by the extent of resection as noted based on the findings at surgery and the postoperative images. Gross-total resection was defined as removal of at least 95% of the tumor and/or no evidence of residual tumor on the postoperative image, subtotal resection was considered to be removal of 25 to 94%, and a biopsy was defined as resection of less than 25% of tumor volume. Furthermore, the oncological outcome was described with the overall survival and the progression-free survival times.

The postoperative outcome was classified neurologically based on the postoperative evolution of symptoms (that is, improved, unchanged, or worse). Surgical morbidity, such as infections and wound-healing disturbances, and general morbidity, such as extended hospital stay, were noted. The radiation treatment and chemotherapy used, if any, were noted and discussed in the context of the available information in the literature (Tables 2 and 3).

**Results**

Twelve of the 14 patients in the database identified as having myxopapillary ependymoma as their histopathological diagnosis could be included with sufficient available follow-up information described earlier. The mean follow-up time was 5.31 years (range 0.17–20.8 years). All children had a myxopapillary ependymoma diagnosed at 18 years of age or younger. There were 10 boys (71%) and four girls ranging in age from 7 to 18 years (mean 12.6 years).

**Clinical Presentation**

The clinical presentation of the tumor course was slow and indolent, with an average symptom duration of 19.6 months. Among the patients who presented with recurrent tumor, the average symptom duration was 6.7 months. For

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### TABLE 1

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Previous Op</th>
<th>Radiotherapy/Chemotherapy</th>
<th>Signs/Symptoms</th>
<th>Duration of Symptoms (mos)</th>
<th>Location of Tumor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16, M</td>
<td>yes</td>
<td>no/no</td>
<td>pain in RUE, back, &amp; LEs, &amp; LE weakness</td>
<td>1†</td>
<td>L4–5, L5–S1</td>
</tr>
<tr>
<td>2</td>
<td>13, M</td>
<td>yes</td>
<td>yes (after 2nd op)/no</td>
<td>pain in LEs &amp; back, gait impairment &amp; abdominal pain</td>
<td>15†</td>
<td>L4–S2</td>
</tr>
<tr>
<td>3</td>
<td>18, M</td>
<td>yes</td>
<td>yes (after 2nd op)/no</td>
<td>pain in back</td>
<td>1†</td>
<td>T4–6</td>
</tr>
<tr>
<td>4</td>
<td>10, F</td>
<td>yes</td>
<td>yes (after 4th &amp; 5th op)/yes (after 5th op)</td>
<td>paraplegic, pain in back &amp; LEs, LE paresthesias, gait impairment, LE weakness, urinary incontinence, &amp; bowel difficulties</td>
<td>5†</td>
<td>T8–L2</td>
</tr>
<tr>
<td>5</td>
<td>10, F</td>
<td>no</td>
<td>no/no</td>
<td>pain in back &amp; in RLE</td>
<td>1†</td>
<td>T12–L2</td>
</tr>
<tr>
<td>6</td>
<td>9, M</td>
<td>yes</td>
<td>yes/no</td>
<td>pain &amp; stiffness in back</td>
<td>1†</td>
<td>T3–4, T3–9, L3–5</td>
</tr>
<tr>
<td>7</td>
<td>16, M</td>
<td>no</td>
<td>no/no</td>
<td>severe pain in LEs &amp; back, urinary incontinence, back stiffness, &amp; LE weakness</td>
<td>36</td>
<td>L3–S3</td>
</tr>
<tr>
<td>8</td>
<td>7, M</td>
<td>yes</td>
<td>no/no</td>
<td>pain in back &amp; buttocks</td>
<td>3†</td>
<td>S1–3</td>
</tr>
<tr>
<td>9</td>
<td>9, M</td>
<td>no</td>
<td>no/no</td>
<td>pain in LEs, bladder incontinence, bowel difficulties, LE paresthesias, &amp; gait impairment</td>
<td>66</td>
<td>L3–S1</td>
</tr>
<tr>
<td>10</td>
<td>11, F</td>
<td>yes</td>
<td>no/no</td>
<td>pain in LEs &amp; RLE weakness</td>
<td>1†</td>
<td>T11–L2</td>
</tr>
<tr>
<td>11</td>
<td>18, F</td>
<td>yes</td>
<td>yes (after 1st op)/no</td>
<td>pain in back, urinary incontinence, &amp; LLE weakness</td>
<td>9†</td>
<td>T12–S3</td>
</tr>
<tr>
<td>12</td>
<td>9, M</td>
<td>no</td>
<td>no/no</td>
<td>pain in LEs</td>
<td>1†</td>
<td>L2–4</td>
</tr>
<tr>
<td>13</td>
<td>15, M</td>
<td>yes</td>
<td>yes (after 1st op)/no</td>
<td>pain &amp; paresthesias in LEs, RLE weakness &amp; spasticity</td>
<td>24†</td>
<td>T5–6, T4–S5</td>
</tr>
<tr>
<td>14</td>
<td>15, M</td>
<td>no</td>
<td>no/no</td>
<td>pain &amp; stiffness in back &amp; gait impairment</td>
<td>24†</td>
<td>T11–L3</td>
</tr>
</tbody>
</table>

* LE = lower extremity; LLE = left LE; RLE = right LE; RUE = right upper extremity.
† Recurrent tumor.
patients who presented with no history of myxopapillary ependymoma, the mean symptom duration was 26.4 months. Signs and symptoms included the following: pain, sensory changes, motor deficits, back stiffness, and bladder abnormalities. All children presented with lumbar, sacral, or radicular pain, but only 29% had sensory abnormalities on physical examination. Back stiffness was a common complaint in children and was seen in 29% of them. Motor deficits and urinary difficulties were seen in 64 and 21% of our cases, respectively.

Before referral to our institution, nine patients had undergone surgery. Of these, one underwent tumor biopsy, three had subtotal resection, and five had a gross-total resection. Magnetic Resonance Imaging

Magnetic resonance imaging was the primary diagnostic modality in all patients. The majority of the masses were seen in the lower thoracic and lumbar regions of the spine. On T1-weighted images the mass appeared isointense relative to the spinal cord, and on T2-weighted images the mass was generally hyperintense. After contrast administration, most tumors enhanced intensely but with varying homogeneity. Surgical Procedure

The overall disease-free progression is shown in Fig. 1

## TABLE 2

### Surgical and long-term outcome of children with myxopapillary ependymoma

<table>
<thead>
<tr>
<th>Case No.</th>
<th>ME Ops at Our Institution/Total</th>
<th>Radiotherapy/ Chemotherapy</th>
<th>FU (mos)</th>
<th>Condition of Last FU</th>
<th>Dissemin on Last MRI</th>
<th>Recurrent Tumor Seen on Most Recent MRI Compared w/ Initial MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0/2 no/no</td>
<td>3 same</td>
<td>yes</td>
<td>metastases at L3–4 &amp; L4–5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1/3 no/no</td>
<td>97.05 improved</td>
<td>no</td>
<td>recurrence at L4–5 &amp; L5–S1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1/3 no/no</td>
<td>404.92 improved</td>
<td>no</td>
<td>no recurrent or residual tumor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1/6 no/no</td>
<td>131.25 improved</td>
<td>no</td>
<td>no recurrent or residual tumor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1/1 no/no</td>
<td>38.7</td>
<td>no</td>
<td>no recurrent or residual tumor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0/1 no/no</td>
<td>3 same</td>
<td>yes</td>
<td>multiple enhancing rounded masses in canal in sacral region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2/2 no/no</td>
<td>57.67 improved</td>
<td>yes</td>
<td>multiple areas of seeding along cervical cord &amp; posterior fossa; abnormality along floor of maxillary sinuses; ependymoma spread along ventricular system &amp; arachnoid spaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1/2 no/no</td>
<td>206.21 improved</td>
<td>yes</td>
<td>residual tumor dissemin at tip of dural tube</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Dissemin = dissemination; FU = follow up; NA= not available; ME = myxopapillary ependymoma.

## TABLE 3

### Intradural myxopapillary ependymoma—a review of the pediatric literature

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Patients</th>
<th>Mean Age (yrs)</th>
<th>M/F Ratio</th>
<th>Prodrome Extent of Initial Tumor Resection Adjunct Therapy Administered After Primary Resection</th>
<th>FU (mos)</th>
<th>Death</th>
<th>Dissemin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan et al., 1984</td>
<td>7</td>
<td>10.6</td>
<td>5:2</td>
<td>10.6 2 SR, 5 TR 2 SR, Rx</td>
<td>2 TR</td>
<td>105.6</td>
<td>2</td>
</tr>
<tr>
<td>Sonneland et al., 1985</td>
<td>15</td>
<td>NA</td>
<td>10:5</td>
<td>NA 2 SR, 5 TR 2 SR, Rx</td>
<td>NA</td>
<td>NA</td>
<td>5 NA</td>
</tr>
<tr>
<td>Ross et al., 1993</td>
<td>3</td>
<td>10.7</td>
<td>2:1</td>
<td>3 TR 3 TR, Rx</td>
<td>NA</td>
<td>93.3</td>
<td>1 1</td>
</tr>
<tr>
<td>Do-Dai et al., 1995</td>
<td>1</td>
<td>12</td>
<td>0:1</td>
<td>2.0 1 biop 1 Rx, chemo</td>
<td>NA</td>
<td>6.0</td>
<td>1</td>
</tr>
<tr>
<td>Nagib &amp; O’Fallon, 1997</td>
<td>3</td>
<td>9.3</td>
<td>1:2</td>
<td>20.3 1 TR 1 TR, Rx</td>
<td>42.7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Schill, 1998</td>
<td>2</td>
<td>NA</td>
<td>NA</td>
<td>NA 1 TR</td>
<td>NA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Graf et al., 1999</td>
<td>1</td>
<td>1.5</td>
<td>1.0</td>
<td>3.0 1 TR</td>
<td>1 TR</td>
<td>720</td>
<td>1 1</td>
</tr>
<tr>
<td>Chinn et al., 2000</td>
<td>3</td>
<td>11</td>
<td>2:1</td>
<td>11.3 1 SR, 2 TR 1 SR, Rx</td>
<td>1 SR</td>
<td>69.3</td>
<td>3</td>
</tr>
<tr>
<td>Merchant et al., 2000</td>
<td>4</td>
<td>11.3</td>
<td>2:2</td>
<td>4 SR 2 SR, chemo, Rx; 2 SR, Rx</td>
<td>1 SR</td>
<td>69.3</td>
<td>3</td>
</tr>
<tr>
<td>Gelabert-Gonzalez et al., 2001</td>
<td>1</td>
<td>15</td>
<td>0:1</td>
<td>2.0 1 TR</td>
<td>0.0</td>
<td>6.0</td>
<td>0</td>
</tr>
<tr>
<td>Hallacq et al., 2003</td>
<td>1</td>
<td>13</td>
<td>1:0</td>
<td>5.0 1 TR</td>
<td>NA</td>
<td>60</td>
<td>NA</td>
</tr>
<tr>
<td>Fassett et al., 2005</td>
<td>5</td>
<td>11.2</td>
<td>4:1</td>
<td>16.3 3 SR, 2 TR 3 SR, Rx, 1 TR</td>
<td>1 SR</td>
<td>51</td>
<td>4</td>
</tr>
<tr>
<td>present series</td>
<td>14</td>
<td>12.6</td>
<td>2:5:1</td>
<td>23.21 2 biop, 4 SR, 7 TR, 1 unk</td>
<td>2 biop, 4 SR, 7 TR, 1 unk</td>
<td>67.5</td>
<td>6</td>
</tr>
<tr>
<td>summary</td>
<td>60</td>
<td>12.0†</td>
<td>2:2:1†</td>
<td>10.4† 3 biop, 14 SR, 25 TR, 1 unk</td>
<td>1 biop, 10 SR, Rx; 2 SR, chemo, Rx; 7 TR, Rx; 1 Rx, chemo</td>
<td>111.2†</td>
<td>7 22</td>
</tr>
</tbody>
</table>

* Biop = biopsy; chemo = chemotherapy; Rx = radiation; SR = subtotal resection; TR = total resection; unk = unknown; — = not applicable. † Mean values.
Thirteen gross-total resections and three subtotal resections were performed. A total of four children underwent their first operation at our institution. Of these, three underwent a gross-total resection and one a subtotal resection. Eight of the 12 children had undergone surgery before treatment at our institution. Six of these patients had a gross-total resection. One child had two more surgeries (Case 13), and another child had one more operation (Case 11). All of these additional operations were gross-total resections. The extent of tumor resection was not influenced by tumor size, sex, patient age, or prior therapy.

Neurological Outcome

At last follow up, the conditions of eight patients had improved and three had stabilized compared with their preoperative clinical status. The condition of one patient had worsened. Three children developed bowel and bladder difficulties over the course of the follow-up period. One child developed these complications after the first surgery, another child after the second procedure, and the remaining child after the third resection. Three children continued to experience significant low-back and leg pain at the conclusion of the study period. Two children suffered long-term sensory loss in the lower extremities.

Surgical Complications

There were no deaths due to surgery. Four children experienced significant complications following treatment. One patient developed hydrocephalus secondary to meningitis after the second surgery. Six months following surgery, another patient underwent surgery for a thoracic syrinx and tethered cord. Two months later this patient became paraplegic. Due to a recurrent metastasizing tumor, another patient underwent surgery for a thoracic syrinx and tethered cord. A fourth child underwent surgery to fenestrate a cyst at the cervicothoracic junction where there was also a disseminated tumor. One child developed mild kyphosis as a result of multiple surgeries; however, he did not require surgery to address this problem during the follow-up period. Additionally, two patients developed mild scoliosis that did not require surgical correction.

Adjuvant Therapy

Five children had undergone radiation treatment prior to referral to our institution. One child received radiotherapy twice. Only one child at our center underwent radiation therapy a second time. Figure 1 right illustrates the disease-free survival in the patients who underwent radiotherapy and those who had not and demonstrates no significant difference between these groups. One child, who experienced multiple recurrences, received chemotherapy after her fifth surgery. All children who underwent adjuvant therapy had suffered from recurrent and/or metastatic disease.

Discussion

Demographics, Diagnosis, and Outcome

The clinical presentation of myxopapillary ependymomas with regard to patient age and duration of symptoms does not differ significantly from other intradural tumors that occur below the cord in the region of the terminal filum. Most patients, like those in the group presented here, typically experience nonspecific symptoms for a rather long period of time, often months and even years before diagnosis. Table 3 summarizes the recent literature about myxopapillary ependymomas. Signs and symptoms appear to be related to size, local extent, and site of presentation. This insidious disease development is due to the slow and indolent growth of these tumors from their origin in the conus medullaris and/or cauda equina. By the time patients present with symptoms, their MR images often demonstrate tumors that span multiple vertebral levels and typically have enlarged the filum. The most common complaint is pain, which was present in all children in this series. Other common symptoms include lower back discomfort, sciatica, weakness, loss of sensation, and bladder and bowel dysfunction. Authors of some studies have examined the prognostic effect of symptoms, signs, and cytological features on long-term survival, but no clear correlation has been identified. Needless to say, no links or predisposing factors such as environmental, carcinogenic, or hereditary conditions have been demonstrated to date.

Magnetic Resonance Imaging

Magnetic resonance imaging is the imaging modality of choice for the evaluation of myxopapillary ependymomas because it identifies the extent of the tumor and its relationship to intraspinal structures. It also allows visualization of the conus medullaris and cauda equina both above and below the tumor and will identify leptomeningeal dissemination along the spinal axis and, particularly, drop metastases in the subarachnoid space at the lower end of the dural sac. Such information is important for preoperative surgical planning. However, MR imaging findings in myxopapillary ependymomas are nonspecific, even though certain features can help narrow the differential diagnosis. These fea-

![Fig. 1.](image-url)
Myxopapillary ependymomas in children

tures include the following: an intradural extramedullary thoracolumbar mass; tumor extension for several vertebral levels in the lumbar and sacral canal; hypo- to isointense appearance of the tumor on T1-weighted images and hyper-intense appearance on T2-weighted images, mostly but not always homogeneously enhanced after intravenous contrast administration; a region of slightly lower intensity at the tumor margin on T2-weighted sequences; and existence of cystic rostral or caudal degeneration (in 50% of cases).14,15,27,33,64 Due to the likelihood of recurrence and seeding of the cerebrospinal fluid spaces, imaging studies should assess the entire neuraxis and include contrast-enhanced images.

Surgical Treatment

Due to the rarity of these tumors there are no binding therapeutic guidelines derived from the few published studies. Treatment thus stems from experience and commonsense pragmatism and consists of the most radical resection possible with the least risk of morbidity. No prospective or controlled studies have been conducted to determine the optimal treatment options, particularly options (or lack thereof) for adjunctive treatment. As with the more frequent intramedullary spinal cord ependymomas, radical surgery for myxopapillary ependymoma is associated with a favorable oncological and neurological outcome in both children and adults.6,38 The benign prognosis of myxopapillary ependymomas, as suggested by Schweitzer and Batzdorf,58 may be due to their anatomical location rather than their histological features. The isolation of these lesions from direct access to lymphatic or other routes of dissemination may prevent more malignant behavior. Currently, no identified histopathological features or the MIB-1 index appears to predict the natural history, likelihood of recurrence, or metastases.46,49,58

Complete resection of this tumor is relatively straightforward if the tumor is circumscribed; however, this surgery may be treacherous, especially if the mass has an intramedullary component within the conus medullaris. Manipulation of the surrounding neural tissue may cause irreversible neurological injury; therefore, meticulous care must be taken because nerve roots may be completely embedded in tumor tissue when the growth pattern is primarily disseminated rather than circumscribed.10,56

Oncological Outcome

Because of the usually present excellent cleavage plane, benign histological findings, and slow growth of myxo- papillary ependymomas, these lesions are highly amenable to gross-total resection and have an excellent prognosis without the need for postoperative radiation therapy.12,50,61 Improved long-term survival is associated with gross-total resection rather than subtotal resection.1,49 In the largest study to date Sonneland and colleagues51 examined 77 patients and found that those who underwent gross-total tumor removal had a significantly longer survival; decreased long-term morbidity, rate of recurrence, and need for a second operation; and long-term disease-free survival. The data from our series support this conclusion for the pediatric population.

Patients should be observed postoperatively with serial MR imaging to monitor for tumor recurrence, even in the case of a gross-total resection.24 Recurrence rates of 10 to 19% have been reported even after gross-total resection.5,38,61 A second resection should be considered, when feasible, to remove residual tumor given the improved survival rates associated with more complete tumor removal.58 Because other treatment modalities are either less effective in controlling the primary tumor (radiotherapy) or are of unproven value (chemotherapy) and have known side effects, we and many authors suggest deferring adjuvant therapy in patients with neuroimaging-confirmed total resection. It appears that the primary pattern of failure is local recurrence.

Tumor recurrence and metastases have been related to a clinical history of less than 1 year, the extent of resection, atypical histological findings, and the location in the spinal cord.49,54,58 In a study of 140 CNS tumors, Rezai et al.49 found that myxopapillary tumors were 3.6 times more likely to disseminate than other low-grade tumors. When local recurrence occurs, repeated operation should be considered, especially if there is no evidence of disseminated disease.

Five patients in our group experienced tumor recurrence. Although anaplastic transformation is unlikely to occur, myxopapillary ependymomas have a tendency to invade locally and to recur in approximately 15 to 33% of patients.8 Our recurrence rate was similar to that reported in the literature (36%). Extraneuronal metastases from these tumors are rare in children, but several cases of intracranial seeding from myxopapillary ependymomas in the conus medullaris and/or terminal filum have been reported.2,3,9,25,26,29,33,35,43,47,53,65

Myxopapillary ependymomas tend to behave more aggressively in children than in adults. The tumors may spread via the subarachnoid space, invade locally, or, in exceptional cases, even metastasize outside the CNS.11,20 Tumor dissemination has been reported in up to 80% of all pediatric cases.13,39

The 5-year survival rate for myxopapillary ependymoma has been reported to range from 85 to 100%.7 In the present study the overall survival rate, after 8.8 years of follow up, was 100%. Survival is believed to be improved in patients who have undergone extensive initial resections. This aggressive initial approach is also associated with a longer disease-free interval.36,38 One patient in the present study, whose tumor behaved in a more aggressive manner, experienced multiple recurrences. This patient underwent six surgeries as well as both radiotherapy and chemotherapy for her tumor. No metastases to extraneural structures were found on follow-up examination in this patient. This exceedingly rare complication has only been reported in five cases of myxopapillary ependymoma in the literature. This small group of patients survived on average for 17.8 years.20 More frequently, myxopapillary ependymomas have occurred in ectopic sites such as the sacrum and presacral tissue where ependymal cell rests may be found. These ectopically located tumors have a worse prognosis and a higher rate of extraneural metastasis.5,33,35,66,67

Debate surrounds the management of tumors that can only be partially resected at the time of surgery.36,38,41,57 Although ependymomas are radiosensitive, the therapeutic benefits are hard to assess due to this tumor’s benign, slow-growing nature. Figure 1 left demonstrates the disease-free survival regardless of whether the patient underwent radiotherapy, indicating no difference in disease-free survival between the two groups. In a review of 131 reported cases of myxopapillary ependymomas, Ross and Rubinstein25 found
no difference between patients who had undergone radiotherapy and those who had not after total or subtotal resection. However, authors of more recent studies have strongly suggested that postoperative radiotherapy for patients who have undergone subtotal resection is the best treatment option because of the high long-term recurrence rate. An analysis by Schild et al. determined that patients who were administered doses exceeding 5000 cGy compared with those who received lower doses had a greater 5-year local control rate (100% compared with 67%). Authors of other studies have shown good tolerance, fewer local failures, and an improvement in survival for patients who received greater than 4500 cGy. Unfortunately, despite radiotherapy following a gross-total resection, some patients may experience recurrence and dissemination within the CNS. Although there are no data to suggest the best management strategy, radiation therapy is often used in such cases.

The benefit of adjuvant therapies should be explored primarily in patients with postoperative residual or unresectable lesions. There is a marked paucity of data to support the role of chemotherapy or chemoradiotherapy. To date only a few small studies have been performed, but there are not sufficient data at this time to determine a role for chemotherapy in the management of myxopapillary ependymomas. The use of chemotherapy is restricted at this time to disease that is refractory to resection and radiation therapy. The optimal treatment strategy for children with myxopapillary ependymoma is still being determined. In both children and adults, gross-total resection is associated with a more favorable long-term outcome. Further therapy should be deferred in patients with a radiologically confirmed total resection. From the few published reports to date, varying recommendations exist for the management of recurrent and disseminated disease. Should the tumor be monitored and resected again, or should radiotherapy be administered? The potential complications of radiation therapy on a developing CNS (impairment of spinal growth, radiation myelopathy, poor wound healing, and radiation-induced tumors) make radiation therapy a risky treatment option that should be approached with caution.

In our study the majority of children with residual or recurrent disease who underwent a second operation had a favorable outcome, and many exhibited no signs of residual or recurrent disease on the last MR image. Radiotherapy did not cure the disease in any of these children, and it is questionable if it deferred recurrence.

Conclusions

The optimal overall treatment of children harboring myxopapillary ependymomas of the spinal cord remains somewhat debatable. As we have confirmed in our study, excellent outcomes may be accomplished through aggressive surgical techniques with the goal of gross-total resection; however, the risk of recurrence remains. Therefore, periodic MR imaging of the neuraxis and clinical follow-up examinations are warranted throughout the patient’s life. The role for adjunctive chemo- and radiotherapy remains to be defined, but there is certainly a role for radiation treatment in the case of recurrent and/or disseminated disease.

References

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