Spinal cord astrocytoma

see also Spinal cord glioma.

see also Cervical spinal cord astrocytoma.

see also Spinal cord glioblastoma multiforme

Epidemiology

Spinal astrocytomas are the second most common spinal cord tumor overall, representing 40% of intramedullary tumor.

They account for 60% of paediatric intramedullary tumours, making them the most common spinal cord tumour in children.

The peak incidence of spinal astrocytomas occurs in the third decade, with the mean age at presentation being 29 years. Males are somewhat affected more commonly than females (M:F = 3:2) [1) 2) 3)].

Associations

There is an increased incidence in neurofibromatosis type 1.

Clinical presentation

Clinical presentation is similar to that of other intramedullary spinal tumours, with pain, weakness and sensory changes common. Bowel and bladder dysfunction are uncommon.

Neuropathic pain was the principal revealing symptom (76 % of cases) [4)].

Pathology

Spinal cord astrocytomas generally have a lower histologic grade than astrocytomas in the brain (see grading of astrocytomas). In adults, 75% are low-grade neoplasms. Up to 25% are anaplastic astrocytomas. Glioblastoma multiforme represent only 0.2-1.5% of spinal cord astrocytomas. In children younger than 3, 80% are either grade I or II 5.

All astrocytomas are characterised by hypercellularity and the absence of a surrounding capsule. In contrast to cord ependymomas, a cleavage plane is not present in most intramedullary spinal astrocytomas.

High grade tumours are more likely to demonstrate extensive leptomeningeal spread seen in up to 60% of spinal cord glioblastomas.

The level of discordant diagnoses in children and adolescents with institutional diagnosis of high-grade glioma (HGG) of the spinal cord was 44% in a experience. However, there was no significant difference in outcome between patients with confirmed and discordant diagnosis. This group of tumor deserves a specific attention in future trials [5)].

Radiographic features

General imaging features

The most common location of astrocytomas is the thoracic cord (67%), followed by the cervical cord (49%), and tumour may of course involve both regions. Involvement of the entire spinal cord (holocord presentation) may occur and is more common in children than in adults. Isolated conus medullaris involvement is seen only rarely (3%) and involvement of the filum terminale is rare (whereas this is the typical location of myxopapillary ependymomas).

Astrocytomas are typically long multisegment intramedullary masses that cause diffuse cord expansion. The average length of involvement is 4-7 vertebral body segments 5,7.

Plain film/CT

Can be often normal however as these tumours are slow growing bony remodelling is not infrequently visible, with posterior vertebral body scalloping or thinning of the pedicle or laminae. Scoliosis is also present in a reasonable number of patients, especially in children presenting with holocord involvement 5. These features are however less common than in spinal ependymomas.

On CT expansion of the cord is frequently visible, but due to the lower contrast resolution compared to MRI can be subtle. If contrast is administered contrast enhancement is frequently visible.

Myelography

May show non specific multisegmental cord enlargement, and may results in a block to normal flow of contrast past the lesion, although this is more common with ependymoma.

MRI

MRI is the diagnostic modality of choice: spinal cord astrocytomas are iso- to slightly hypointense on T1, hyperintense on T2 and commonly have associated cysts. They enhance less intensely [6].

As astrocytomas arise from cord parenchyma (rather than the central canal as is the case for ependymomas), they typically have an eccentric location within the spinal cord. They may be exophytic, and even appear largely extramedullary. They usually have poorly defined margins. Peritumoral edema is present in 37% 8. Intratumoural cysts are present in approximately 21% and peritumoral cysts are present in aproximately 16% 8.

Unlike ependymomas, haemorrhage is uncommon.

Reported signal characteristics include:

T1: isointense to hypointense

T2: hyperintense

T1 C+ (Gd)

vast majority enhance (used to thought that all enhance but this is not the case)

usually patchy enhancement

Differential diagnosis

Spinal cord astrocytoma vs. Spinal cord ependymoma: On occasion, these entities can be difficult to distinguish during intraoperative consultation, especially as most spinal cord biopsies for frozen interpretation are minute. Due to the critical surgical implications of the accuracy of the frozen section diagnosis for intramedullary spinal gliomas, a careful discussion should be had between the surgeon and pathologist at the time of intraoperative consultation.

Certain imaging features may help to differentiate between the two:

Ependymoma

more common in adults

scoliosis and bony remodelling more common

central location in spinal canal

well-circumscribed

haemorrhage is common

may rarely present as a subarachnoid haemorrhage

hemosiderin staining especially at the superior and inferior margins (so-called hemosiderin capping) is common focal, intense homogeneous contrast enhancement more frequent and more prominent cysts (intratumoral and polar)

Treatment

see Spinal cord astrocytoma treatment.

Prognosis

Astrocytomas are generally faster growing than ependymomas and typically have a worse prognosis.

Outcome for low-grade astrocytomas is less favorable than that of ependymomas with regard to both recurrence and function though many have prolonged survival. There is no correlation of extent of resection and recurrence. Outcome for high-grade tumors is extremely poor; tumor progression is relentless; median survival is thirteen months in children and six months in adults [7].

Cord astrocytomas in children tend to be associated with a good prognosis, as they behave much like grade I cerebellar pilocytic astrocytomas and displace neural tissue rather than infiltrate it.

A retrospective review of 46 consecutive patients with spinal cord astrocytomas treated from 1992 to 2012. Univariate and multivariate analyses were used to identify variables associated with survival.

The majority of patients (67.4%) underwent surgical resection, with the remaining only receiving biopsy. Of those who underwent resection, only 12.5% of patients underwent gross total resection, all of whom had low-grade astrocytomas. Of all patients, 30.7% worsened compared with their preoperative baseline. The occurrence of worsening increased with high tumor grade (52.9% vs.

27.6%, P = 0.086) and an increased extent of resection (66.7% vs. 18.8%, P = 0.0069). Resection did not provide a survival benefit compared with biopsy alone (P = 0.53). Multivariate analysis revealed high-grade histology (hazard ratio, 11.3; 95% confidence interval, 2.41-53.2; P = 0.0021), tumor dissemination (hazard ratio, 4.24; 95% confidence interval, 1.22-14.8; P = 0.023), and an increasing number of tumor involved levels (hazard ratio, 1.31; 95% confidence interval, 0.99-1.74; P = 0.058) to be associated with worse survival.

As surgical intervention is associated with a higher rate of neurological complications and lacks a clear benefit, the resection of spinal cord astrocytomas should be reserved for select cases and should be used sparingly [8)].

Case series

2017

Parker et al. performed a retrospective analysis of all the patients with IA operated on between 1984 and 2011 at 7 French centers (Kremlin-Bicêtre, Lille, Lyon, Marseille, Montpellier, Nice, and Nîmes). The minimum follow-up was 12 months. The clinical evaluation was based on the McCormick scale (MCS) results from the pre- and postoperative period. RESULTS: Data from 95 patients with a pathologically confirmed diagnosis of IA were considered: 54 patients were treated at the Neurosurgical Department of Kremlin-Bicêtre Hospital, 8 were treated at Lille and 33 were treated in the south region of France. The epidemiological analysis was performed on the whole cohort of patients while follow-up considerations were made solely on the 54 patients managed at Kremlin-Bicêtre Hospital to obtain homogeneous data. The average age at diagnosis was 35.6 years without significant gender difference (47 % men for 53 % women). The age at first clinical manifestation was 33.7 years. The average duration of the symptoms before the diagnosis was 22.9 months. Neuropathic pain was the principal revealing symptom (76 % of cases). The localization of IA was thoracic in 40 %, purely cervical in 28.4 %. Complete removal was achieved in 29.5 % of cases when considering the whole cohort and in 38 % of cases treated at Bicêtre Hospital. The histological distribution recorded was: grade 1 in 35 %; grade 2 in 35 %; grade 3 in 22 % and grade 4 in 8 %. During the early postoperative period (3 months) a worsening of functional capacity was observed with an increase in the frequencies of ranks 3 and 4 of MCS in 18.4 %. At 5 years follow-up, the frequencies of ranks 1 and 2 were increased. The application of a Cox model for the determination of the relative risk of death for IA grade 1 and 2 (66 patients) showed a probability of survival at 5 years of 78.6 % (CI 95 %: 68.6 %-87.6 %). Survival at 10 years is to 76.8 % (CI 95 %: 62.3 %-84.2 %). CONCLUSION: Surgery is indicated if the patient is symptomatic or the tumor increases in size. A radical excision remains the mainstay of treatment, while searching to preserve the motor function. A total resection was however only possible in 38 % of cases. A regular postoperative follow-up is compulsory and the adjuvant treatment is based on chemotherapy and radiotherapy according to the histological type [9)].

2016

A consecutive retrospective chart review of all patients who underwent intramedullary spinal cord astrocytoma resection at a single tertiary-care institution between January 1996 and December 2011 was conducted. Molecular data collected included p53 mutation status, proliferative activity (Ki-67), 1p/19q chromosome loss, and EGFR amplification. Multivariable logistic and Cox proportional hazards regression were used to identify variable associated with postoperative outcomes. RESULTS: Among 13 patients undergoing surgical resection followed for a median of 54 months, 54% experienced improvement in neurological status, while 15% remained unchanged and 31% deteriorated. Following resection, the 5-year local control (LC), progression-free survival (PFS), and overall survival (OS) rates were 83%, 63%, and 83%. Median PFS time was found to be 5.6 years. Multivariable regression

revealed limited characteristics associated with postoperative outcomes, though no molecular characteristics were found to be prognostic. Older age at surgery predicted decreased probability of PFS (HR 0.91, 95% CI 0.81-0.99, p=0.03) and trended towards predicting lack of neurological improvement (OR 0.94, 95% CI 0.83-1.02, p=0.21) and decreased OS (HR 0.93, 95% CI 0.81, 1.03, p=0.15). Preoperative motor symptoms (OR 0.12, 95% CI <0.01-1.91, p=0.14) and adjuvant chemotherapy (OR 0.07, 95% CI <0.01-1.82, p=0.12) also trended towards predicting lack of neurological improvement. CONCLUSION: Age was the only patient variable found to have a statistically significant association with profession-free survival and no other factors were significantly associated with postoperative outcomes. These findings were limited by a relatively small sample size; thus, future studies with increased power investigating the prognostic effects of molecular characteristics could provide further clarity in identifying patients most likely to benefit from surgical resection [10].

Over a period of 20 years, among 215 patients with IMSCT 22 patients with astrocytomas were identified and enrolled into this analysis. Demographic data, clinical symptoms, localization and extension of the tumor, resection rate as well as pre- and postoperative neurological status were obtained. Patients were followed-up clinically and by MRI.

Complete resection rate was higher in cervically located tumors (9 of 10) compared to non-cervical tumors (7 of 12). Tumor extension (1-3 segments vs. > 3 segments involved) did not influence on the resection rate. Cervical tumors showed a trend for better postoperative functional outcome than non-cervical lesions (3 of 10 cervical but 6 of 12 non-cervical tumors deteriorated postoperatively). In tumors extending more than 3 segments postoperative worsening was significantly increased.

The present study shows a better resectability and functional outcome for cervically located intramedullary astrocytomas. Tumors extending more than three segments deteriorated significantly. These findings may help for decision-making process and treatment of these tumors [11].

1985

32 cases of spinal cord astrocytoma in patients under 20 years of age who were treated at the Mayo Clinic between 1955 and 1980. There was a 1.3:1 male to female ratio. Twenty patients were between 6 and 15 years of age at the time of diagnosis. The duration of symptoms prior to definitive diagnosis varied from 5 days to 9 years, with an average of 24 months. The most common symptoms were pain (62.5%), gait disturbance (43.7%), numbness (18.8%), and sphincteric dysfunction (18.8%). The most common neurological findings were a Babinski response (50.0%), posterior column sensory dysfunction (40.6%), and paraparesis (37.5%). A median follow-up period of 8.6 years (range 0.8 to 25.5 years) revealed that the survival time diminished with increased histological grade of the astrocytoma (p less than 0.001). The development of postlaminectomy spinal deformities represented a serious postoperative complication. This occurred in 13 patients and was first recognized between 8 and 90 months postoperatively. Six deformities occurred following cervical laminectomy, and eight patients required at least one orthopedic procedure. It is crucial to follow these patients for an extended period of time to watch for postoperative spinal deformities [12].

Case reports

Long-level intramedullary astrocytomas complicated with scoliosis are rare. Surgical treatment of such tumors becomes more complicated and challenging when spinal scoliosis is present. However, studies describing the treatment of long segmental intramedullary spinal cord astrocytomas

complicated with severe spine scoliosis have been rarely reported.

Two cases of long-level intramedullary astrocytomas complicated with severe spine scoliosis were surgically treated with a one-stage operation of tumor resection and scoliosis correction in this report. Case 1: A 16-year-old boy presented to our hospital with five-month progressive paresthesia, weakness of the left lower limb, and a long-time abnormal body appearance. MRI showed a T4-T12 intramedullary tumor combined with spinal scoliosis. Case 2: A 14-year-old boy presented at our service with a 6-year history of visible spine scoliosis and a 1-year progressive motor disability of bilateral lower limbs. Spine MRI indicated a long-level abnormal syringomyelia signal from C4 to L1 and there was irregular enhancement after intravenous contrast medium administration at C7-T2 and T9-T12 level.

They performed a laminectomy over the whole length of the tumor and corrected the scoliosis with trans-pedicle screws. The patients exhibited a long-time tumor free with largely neurological function preservation. One-stage operation did not generate severe short- or long-term complications. The correction of the scoliosis prevented the progression of the spinal deformity and facilitated the recovery of normal life.

This case report demonstrates that the one-stage resection of long-level intramedullary astrocytoma and correction of complicated scoliosis might be a feasible option [13].

References

1)

Harrop JS, Ganju A, Groff M, Bilsky M. Primary intramedullary tumors of the spinal cord. Spine (Phila Pa 1976). Oct 15 2009;34(22 Suppl):S69-77.

2)

Horbinski C, Hamilton RL, Nikiforov Y, Pollack IF. Association of molecular alterations, including BRAF, with biology and outcome in pilocytic astrocytomas. Acta Neuropathol. Jan 1 2010;epub ahead of print.

3)

Raco A, Piccirilli M, Landi A, Lenzi J, Delfini R, Cantore G. High-grade intramedullary astrocytomas: 30 years' experience at the Neurosurgery Department of the University of Rome “Sapienza”. J Neurosurg Spine. Feb 2010;12(2):144-53

4) , 9)

Parker F, Campello C, Lejeune JP, David P, Herbrecht A, Aghakhani N, Messerer M. [Intramedullary astrocytomas: A French retrospective multicenter study]. Neurochirurgie. 2017 Feb 2. pii: S0028-3770(16)30134-5. doi: 10.1016/j.neuchi.2016.09.007. [Epub ahead of print] French. PubMed PMID: 28162257.

5)

Bouffet E, Allen JC, Boyett JM, Yates A, Gilles F, Burger PC, Davis RL, Becker LE, Pollack IF, Finlay JL. The influence of central review on outcome in malignant gliomas of the spinal cord: the CCG-945 experience. J Neurosurg Pediatr. 2016 Apr;17(4):453-9. doi: 10.3171/2015.10.PEDS1581. Epub 2015 Dec 18. PubMed PMID: 26684767.

6) , 7)

Houten JK, Cooper PR. Spinal cord astrocytomas: presentation, management and outcome. J Neurooncol. 2000 May;47(3):219-24. Review. PubMed PMID: 11016738.

8)

Babu R, Karikari IO, Owens TR, Bagley CA. Spinal cord astrocytomas: a modern 20-year experience at a single institution. Spine (Phila Pa 1976). 2014 Apr 1;39(7):533-40. doi: 10.1097/BRS.0000000000000190. PubMed PMID: 24384651.

10)

Xiao R, Abdullah KG, Miller JA, Lubelski D, Steinmetz MP, Shin JH, Krishnaney AA, Mroz TE, Benzel EC. Molecular and clinical prognostic factors for favorable outcome following surgical resection of adult intramedullary spinal cord astrocytomas. Clin Neurol Neurosurg. 2016 May;144:82-7. doi: 10.1016/j.clineuro.2016.03.009. Epub 2016 Mar 14. PubMed PMID: 26999530.

11)

Ardeshiri A, Chen B, Hütter BO, Oezkan N, Wanke I, Sure U, Sandalcioglu IE. Intramedullary spinal cord astrocytomas: the influence of localization and tumor extension on resectability and functional outcome. Acta Neurochir (Wien). 2013 Jul;155(7):1203-7. doi: 10.1007/s00701-013-1762-5. Epub 2013 May 23. PubMed PMID: 23700256.

12)

Reimer R, Onofrio BM. Astrocytomas of the spinal cord in children and adolescents. J Neurosurg. 1985 Nov;63(5):669-75. PubMed PMID: 4056869.

13)

Zhang D, Fan W, Zhao X, Massicotte EM, Fan T. Long-level intramedullary spinal cord astrocytoma complicated with spine scoliosis: Report of two cases. Int J Surg Case Rep. 2021 Jan 15;79:234-238. doi: 10.1016/j.ijscr.2021.01.035. Epub ahead of print. PMID: 33485173.