DOI: 10.2478/romneu-2018-0082

A prospective observational study of clinical outcome of operated patients of intradural extramedullary spinal cord tumor in our tertiary care center

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Abstract: *Aim*: This prospective observational study aimed at finding out the efficient clinical and functional factors which affect the surgical outcome on the basis of location of the intradural extramedullary spinal cord tumors (IESCTs) and in follow up period of 1 year post surgery, treated at a single tertiary institution (Vivekananda Polyclinic and Institute of Medical Sciences, Lucknow). *Material and Methods*: We prospectively analyzed 44 consecutive cases of IESCTs diagnosed on radiology and operated at our center from 2014 to 2016. The demographic data, clinical presentation, tumor radiological parameters (axial and saggital location and tumor occupancy ratio), treatment modality, and follow up outcome of these patients are reviewed. We have excluded patients with Neurofibromatosis, recurrent tumors and intradural cauda equina and conus lesions. *Result*: A clinical series of 44 patients with IESCTs, underwent surgery (standard laminectomy) and excision of tumor have been followed for 1 year. The most commonly involved spinal level was dorsal (65.91%) followed by cervical (20.45%) and lumbar (18.18%) spine. The axial location of tumor was dorsal/posterior (6.82%), ventral/anterior (13.64%) while most common axial location of tumor was lateral (79.55%). We have found that the gait disability score and frankel score shows significant improvement within 1 week after surgery and after 1 year of follow up, 90.91 % patients have gait disability score of > 2 while frankel scale has shown, 81.82 % were ambulatory and only 18.18 % were non-ambulatory. *Conclusion*: Analysis of the MRI findings should be undertaken in a routine, standardized fashion to insure the accurate evaluation of the location of the tumor for planning the surgical interventions. As a surgeon we should be more cautious while operating on the purely ventrally located tumors through the posterior approach and we may prefer anterior approach in them. Similarly in saggital location, we should be cautious to operate the thoracic locating tumors to prevent the post-op complications.

Key words: Intradural extramedullary tumors, meningioma, schwannoma, neurofibroma

Introduction

Intradural extramedullary spinal cord tumor (IESCTs) constitute approximately two third of these tumors.[1,3,5,9] The most common primary IESCTs are derived from sheath cells covering the spinal nerve roots (schwannoma and neurofibroma) or meningeal cells located along the spinal cord surface (meningioma)[1]. Spinal nerve sheath tumors account for approximately 40% of all spinal tumors (0.3-0.4 cases annually per 100,000 people).[1,30] while spinal meningioma accounts for about 30% of the IESCTs. Most of the Indian studies have shown male preponderance in IESCTs except in meningioma which has more female preponderance. [1,9] The female preponderance is thought to arise from the sex hormone or other type receptor common in women.[10]

More than 50 % of the IESCTs are located in the thoracic spine, and they occur in the cervical and lumbosacral spine at a similar rate, 22 % and 18 %, respectively.[1,4,9,16] Most nerve sheath tumors are frequently observed in thoracic spine (39%), lumbar spine (32%), and cervical spine (23 %).[7,15,16] Spinal schwannoma arise from dorsal root[1] (hence posterior, lateral or posterolateral in position) and < 5% originating at the anterior (ventral) root[16,18], however as much as 23 % of the cervical nerve sheath tumor have an anterolateral component consistent with ventral root origin.[6,7] Spinal meningioma is nearly 80 % found in thoracic region, in cervical region it is about 14-27 % and of lumbar is about 2-14 % while sacral meningioma are very rare.[1,8,28]

Surgical approach is determined primarily depending on the location of tumors in spinal canal. However tumor consistency and pathology should also be considered.[15] Standard posterior approach through bilateral or unilateral laminectomy provides adequate exposure to safely remove the vast majority of these lesions, without the need for potentially destabilizing facet or pedicle resection.[6,11] Now, modified approaches are used which are minimally invasive and may be routinely used to remove IESCTs.[14,17,22,25] Posterior exposures with varying degree of lateral bone resection, dentate ligament division, and gentle cord rotation may also provide adequate exposure for safe removal of non midline ventro-lateral superficial pial presenting spinal cord lesions.[26,29] Solid ventral midline schwannoma are optimally managed by anterior and anterolateral approaches[6,13,19], although soft consistency tumors can be approached from postero-lateral approach with satisfactory outcome.[15,18] Radiosurgery in intradural spinal tumors is evolving and seems to be an effective tool for the patients, who are not suitable for open surgery, as well as with multiple lesions, recurrences or tumor remnants after microsurgery.[1,32]

Patients and Methods

A prospective review was performed between June, 2014 and June, 2016 of all the consecutive 44 operated patients of IESCTs at our institutions. The study was approved by the ethical committee of the hospital and all the patients involved in this study signed the informed consent. A detailed clinical history elucidated, followed by careful clinical examination, which was recorded as per the performa. Clinical disability was assessed by

the Gait disability scale and Frankel scale in both pre-op, at the time of discharge, 3 months and 12 months follow up.

Diagnostic evaluations included MRI (spine) with or without contrast with an axial slice demonstrating the tumor and the respective spinal column (Saggital and axial) location of the lesion. The axial location of the tumor were categorized as anterior, posterior, or lateral with respect to the spinal cord and were described to correlate with a clock face. The tumors that were predominately between "10 and 2 o' clock " were considered anterior while if tumor predominately occupied "4 to 8 o' clock" then they were considered posterior and those that were either "2 to 4 o' clock" of "8 to 10 o' clock" were considered "lateral". Tumor occupancy ratio[27] was also studied in axial MRI (spine).

Surgery was done in all cases as standard posterior laminectomies[26,29] and unilateral medial facetectomy was done in anteriorly located tumor. Dura was opened in median or paramedian manner and in few ventrally located tumors or with extra dural extension; we opened dura in T shaped manner and may require for cutting the dentate ligament to retract the cord for removal of the tumor. After dural opening, a plane was developed between arachnoid membrane and tumor surface. The tumor was removed en bloc or piecemeal. The involved nerve roots were coagulated and cut in case of schwannoma while in case of meningioma dural origin coagulated using bipolar cauterization in most of cases (Simpson grade II). Gross total excision of tumor done in all cases.

In immediate post-op, complications were noted and neurological status was again assessed at the time of discharge by Gait disability score and Frankel score and then patient was followed up in next 3 months and after 1 year.

Results

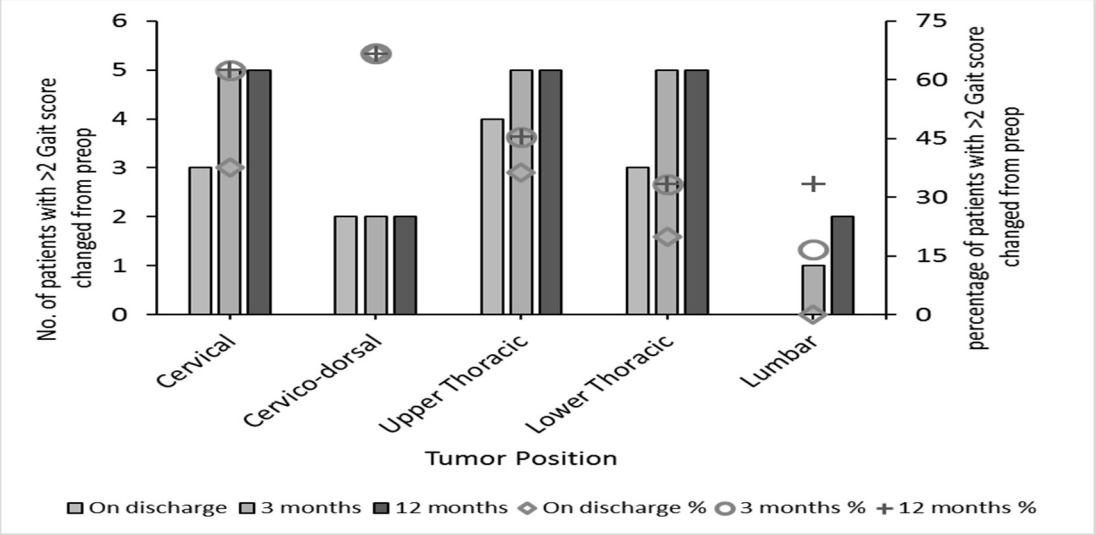
The age of all patients ranged from 16- 75 yrs with mean (±SD): 42.6 (±17.25) yrs. Most of the patients were in 40-60 yrs age group (31.2%) followed by 20-30 yrs (27.27%), > 60 yrs (15.91%) and <20 yrs the least (11.36%). Most patients were male (70.45%) while only (29.55%) were female. The mean age of presentation in male was 38.5 yrs while in female; it was 46.83 yrs. Mean duration of illness was 11 months (male 12.08±12.18, female 9.91±10.60) and it showed no significant difference between the genders.

Around 38.64% patients were of ≤ 5 months duration while only 18.18% were of > 20 months duration. Further, All (100%) patients had back pain, 97.73 % had sensory complaints while 68.18% had myelopathy, 56.85% had motor deficit and 50% had sphincter dysfunction while only 25% had radiculopathy.

The most commonly involved spinal level was Dorsal (65.91%) followed by Cervical (20.45%) and Lumbar (18.18%) spine. It has been found that most common location of tumor was D5-D9 in Meningioma (56.25%) and in Schwannoma most common location is Lower dorsal- lumbar group (39.29%). I have also divided the axial location of tumor into Dorsal (6.82%), Ventral (13.64%) while most common axial location of tumor was Lateral

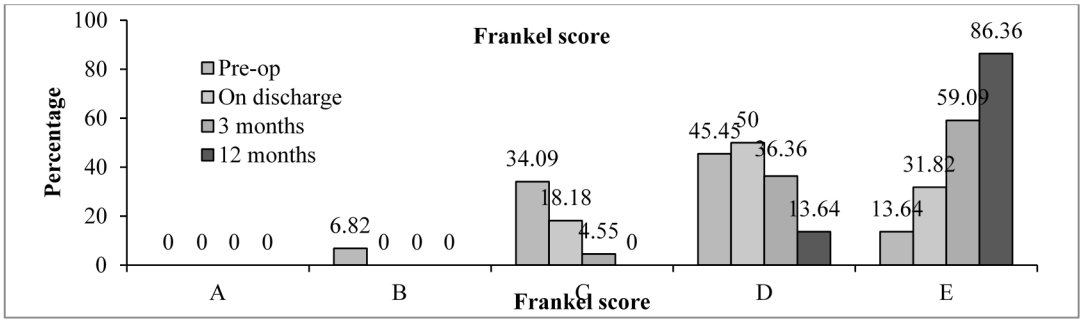
(79.55%) which is approximately similar in both the tumor types.

We have analyzed the saggital location of the tumor with the clinical outcome in all the clinical outcome groups (on discharge/3 months/12 months) and found that patient with thoracic location has more improvement (> 2 grades) in clinical outcome than with other tumor location while least change in disability score was noticed in lumbar group.



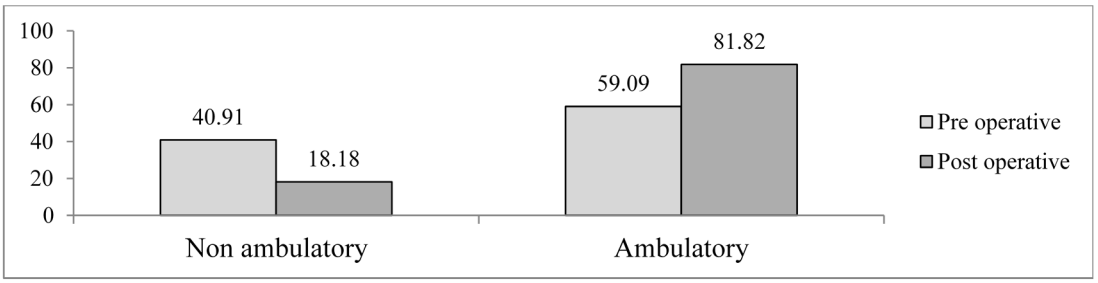
The tumor occupancy ratio was divided into 3 groups (70-80, 80-90 and > 90) and found that found that only 6.81 % have tumor occupancy > 90 % while 70-80 and 80-90 % tumor occupancy was approximately equally divided in 2 groups. I have also analyzed the tumor occupancy ratio with the disability score and found that once the tumor occupancy increased, the disability also increased (r- 0.66, p< .001).

According to Gait disability score, most of the patients at Pre-op were at Grade 4 (38.64%), followed by Grade 2 (25%), Grade 5 (18.18%), Grade 1 (15.91 %) and Grade 3 only 2.27%. The $\chi 2$ test revealed significant improvement in Grade of patients in immediate post-op (7 days after surgery) and then over the periods (12 months) of follow up after surgery. Frankel scale also has shown similar results as most of patients at Pre-op were at Grade D (45.45%), Grade C (34.09%), Grade E (13.64%) and Grade B in only 6.82%. Similarly the $\chi 2$ test revealed significant improvement in Frankel score in immediate post op and then over the periods of follow up after surgery.



Bar diagram of Frankel score in follow up

At final evaluation (i.e. after 12 months), the outcome was that patient was that 90.91% patients have Gait disability score >2 while in Frankel Scale it was shown that after 12 months follow up 81.82 % were ambulatory while only 18.18% were non-ambulatory.



Bar diagram of final outcome

Discussion

Most patients were male (70.45%) while only (29.55%) were female and no significant difference was found between the clinical presentation and duration of illness between the genders. The literature shows the female preponderance in western countries while Asian studies[1,9,21] favors male preponderance although our study reflects more male ratio which may be because of social stigma or delayed follow up of female patients in eastern U.P of Indian population. The female preponderance of meningioma is a well – known entity and our study supports it. We found that meningioma favors the elderly female population while schwannoma are more in young male population similar to the previous literature.[13,15,24] The mean age of presentation in our study was 38 years in male and 46 years in female which is same as compared to that of western world along with other asian studies as Arora et al, 2015[1], Mondle et al, 2016[21], Govind M et al, 2016[9], Iacob G, 2014[12].

The mean duration of illness was 12 months in male patients and 9 months in female patients in our study. It was found that meningioma groups have more myelopathy in upper thoracic spine as reviewed on other studies. Early presentation of the patients are more in upper thoracic spine group which is

explained by the higher cord-to-canal ratio, as well as the tenuous vascular supply to that region of the spinal cord. The lesser mean duration of illness in female may be found due to higher incidence of thoracic locating tumor in female.

No association between the axial location (dorsal- dorsolateral/ventral- ventrolateral) and the clinical outcome was found in our study ($p < 0.26$) supported by Mehta et al, 2013[20], Riad et al, 2013[23], Rinaldo et al, 2016[24] . The extradural component was noted in 6 (14%) of our all patients of nerve sheath tumors which is similar to other studies[22] in literature which is 10 %.

Our study gives the similar results to Mehta et al [20] as the ventrally located tumors trended toward development of neurological deficit as occurred in our 2 patients, although trend not significant ($p= 0.45$). This can also be explained by the difficult approach to purely ventral locating tumor. Mehta et al, 2013 had done the first systemic study to assess the association between axial/saggital tumor location and outcomes and post-operative complication[19]. However, a saggital spinal column level was significantly associated with the development of a neurological deficit, as patients with IESCTs tumors located in upper thoracic spine were more likely to have a post-operative neurological deficit.

I have also analyzed the tumor occupancy ratio with the disability score and found that once the tumor occupancy increased, the disability also increased ($r- 0.66$, $p< .001$). Song et al, 2009[27] and Haq el at, 2015[10] has included this tumor occupancy ratio in their study but has not shown any co relation with the clinical outcome similar to our study. In our study, only 6 (18.18%) has 2 level of column of tumor while majority of the patients 38 (81.1%) has only 1 level of involvement. Stawicki et al, 2007[28] has considered level of tumor as a prognostic factor but our study did not support it.

In case of meningioma we had done gross total excision of tumor with Simpson grade II resection in all of the cases and found no recurrence in the follow-up period as favored by other studies also which consider Simpson grade I and grade II equally effective in complete surgical resection.[2,31] however our follow up was of very short duration to comment on the recurrence. We have done coagulation and cutting of involved rootlet in nerve sheath tumor similar to many of the studies [20] and found no functional neurological deficit even in ventrally located tumors except sensory deficits in few cases in the involved region.

In post-op we have seen that within 7 days after surgery approx 60 % of the patient walking either with minimal support or independently (Grade 4 and 5) within 7 days after surgery similar to Frankel score. Majority (90%) of clinical improvement noted within 3 months of the operative intervention.[24,2] At final evaluation (i.e. after 12 months), the outcome was that patient was that 90.91% patients have Gait disability score >2 while in Frankel Scale it was shown that after 12 months follow up 81.82 % were ambulatory while only 18.18% were non-ambulatory.

Conclusion

Location of the tumor was important to understand the nature and course of the disease in these tumors. We have found deterioration in 2 ventrally located tumors hence we should be careful in operating purely ventral located tumors through posterior/ posterolateral approach and we may prefer anterior approach for purely ventral tumors. In thoracic locating tumors due to higher cord-to-canal ratio, we should always be more cautious and purely ventral and thoracic tumor has higher chances of post-op complication.

MRI findings should be undertaken in a routine, standardized fashion to insure that important details are not missed for more accurate evaluation of location of the tumor along with the measurement of tumor occupancy ratio in all the patients. Radiological finding as tumor occupancy ratio has an impact on the early presentation of the symptoms and thereby defining the role of location of the tumor.

Tumor type on the basis of pathology has also not shown any significant association with the clinical outcome in our study.. We have found that disability score (Gait disability score and Frankel score) both are good clinical outcome predictors in these patients.

We have found that approx 60 % of the patient walking either with minimal support or independently within 7 days after surgery while majority (90%) of clinical improvement noted within 3 months of the operative intervention[3,4,6]. At final evaluation (i.e. after 12 months), the outcome was that patient was that 90.91% patients have Gait disability score >2 while in Frankel Scale it was shown that after 12 months follow up 81.82 % were ambulatory while only 18.18% were non-ambulatory. Thus we should consider that early excision of the tumor for better outcome and recovery.

I have not commented on the recurrence of the tumor because of the limited duration of the study as we know the usual period of recurrence is 3 years and follow up radiology should be done after 5 years after surgery.

Finally the skill of an individual surgeon always be a factor affecting our results and hence can never be ruled out.

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