Primary spinal epidural lymphomas

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An epidural location for lymphoma is observed in 0.1–6.5% of all the lymphomas. Primary spinal epidural lymphoma (PSEL) is a subset of lymphomas, where there are no other recognizable sites of lymphomas at the time of diagnosis. The incidence of this subset of lymphomas is much less. It, however, is increasingly diagnosed, due to the increased use of more sensitive imaging modalities.

In order to study the patient profile, clinical behavior, pathogenesis, radiological and histological findings, prognostic factors, treatment options, and outcomes of the patients with PSEL, a review of the literature was performed. Conclusions and treatment protocols, hence, may be established.

DEFINITION

PSELs are tumors with a characteristic histopathological picture of a lymphoma which are seen purely in the spinal epidural space, with an accompanying negative diagnostic workup for lymphoma at other sites [Figures 1 and 2].

SEARCH STRATEGY

A thorough English literature search was conducted to identify the articles in which PSEL was described. The search
strategy included the search of journals and an analysis of the bibliographies of the journal articles so identified. For the electronic search, Pubmed was used to identify journals that enlisted and enumerated PSEL from 1961 to January 2011. The following combination of terms: “primary,” “spinal,” “epidural,” and “lymphoma” were used. This resulted in the identification of 80 journals. The review focused on the most significant articles and the data were analyzed by the primary and the senior authors. The bibliographies of the articles were reviewed and any other relevant significant studies were also analyzed.

INCIDENCE

In Hodgkin’s lymphoma, approximately 90% of the cases originate from lymph nodes, whereas 10% arise from extranodal regions.[2,3] In less than 0.25% of patients with Hodgkin’s disease there is primary extranodal presentation.[4] Only 5% of patients with Hodgkin’s disease develop spinal cord compression due to an epidural tumor at some time during the course of their disease.[5,6] There are only a few case reports of patients with Hodgkin’s disease who presented with isolated primary involvement of the epidural spinal region.[2,5,7] Love et al, in 1954, described primary Hodgkin’s disease in the spinal epidural space in seven patients, all of whom died within months to years of the initial diagnosis and treatment.[9] Citow et al were critical of this report, suggesting that many of the patients may have had disease elsewhere that were “missed” by the diagnostic methods in use at the time the study was performed.[5,7]

Extranodal non-Hodgkin’s lymphoma (NHL) accounts for 24–48% of all NHL, while PSEL comprises 0.9% of all extranodal NHLs.[10,11] Spinal epidural lymphoma is known to occur in 0.9–6.5% of cases of previously undiagnosed NHL, according to various studies. Less than half of these turn out to be PSELs.[12,14]

PATIENT CHARACTERISTICS

The largest series in the literature to date was presented by Monnard et al. They reported 52 patients who were treated in nine institutions of the Rare Cancer Network between 1982 and 2002.
A male preponderance of 69%, which was similar to other studies, was observed. Patients clinically present most commonly in the fifth to seventh decade of life[15-18] with more than 80% being older than 40 years.[1,14-16,19] Pediatric patients with PSEL, however, have also been reported.[5,20-23]

SYMPTOMS AND SIGNS

The symptoms and signs of PSEL are similar to those of any other epidural tumor, namely weakness of the upper or lower limbs, back pain, neck pain, sensory deficits, and impairment of bladder or bowel function.[1,15] The onset of symptoms is usually subacute, occurring over a few days to weeks.

Back pain is typically present at the level of the epidural tumor. This, in general, is followed by radicular pain, either unilaterally or bilaterally. Myelopathy commonly ensues. Symptoms depend on the location and extent of tumor. Lesions at the conus level are often associated with early sphincter involvement, and those in the cauda equina often have asymmetric sensory and motor levels.[24]

Epelbaum et al described two phases of clinical presentation. The first is the prodromal phase, during which localized back pain and occasional radicular pain occur. This may last for months to a year. In the second phase, a rapid neurological deterioration ensues, usually over 2–8 weeks. The latter is due to spinal cord compression. Similar clinical presentations have been described by others.[12,14,16]

Lymphoma is a disease where “B” symptoms such as weight loss, night sweats, and fever may also be present at the time of presentation. Monnard et al have reported 5.7% of patients to have B symptoms.[15] In PSEL where most of the patients are in either stage I or stage II, systemic symptoms at the time of presentation are significantly low.

LOCATION

The most common region of involvement is the thoracic spine, followed by the lumbar and cervical spine. Monnard et al have reported that the thoracic spine is the site of occurrence in 75% and the cervical spine in 10%.[15] Case reports by many other authors are associated with a preponderance of thoracic spine involvement. This has been attributed to both the greater length of the thoracic spine (compared with the cervical and lumbar) and to an enhanced ability to accommodate bulky disease in the thorax and abdomen.[1,13,14,16-18,23] The rich venous plexus in the thoracic spine may be the reason for frequent occurrence of lymphomas in this site.[31]

Çağavi et al have reported a case of primary extranodal lymphoma at two spinal levels. At the lumbar level there was epidural lymphoma with cord compression. However, at both the levels there was involvement of the vertebral body.[2] Mascalchi et al also reported multiple epidural lymphomas at three different thoracic levels, but even in this case there were diffuse changes seen in the marrow. The spinal lesions extended over multiple levels with a mean of 2.6 vertebral levels.[24]

DIAGNOSIS

After the initial clinical examination suggesting a spinal pathology, a high index of suspicion regarding epidural lymphoma is essential. Once imaging studies confirm the presence of a spinal epidural lesion, further workup and treatment ensues.

Imaging

Because bony involvement is not present, plain radiographs rarely provide clinically useful information. Myelography and computerized tomography (CT)-myelography, as well as magnetic resonance imaging (MRI) are useful for detecting epidural compression.[24,27] MRI is the least invasive and, therefore, the usual procedure of choice. It has several advantages:

- MRI portrays the extent of the epidural lesion much better than myelography.
- MRI is more sensitive for demonstrating multiple epidural lesions.
- MRI clearly demonstrates the paraspinal extent of the lesion.
- MRI is the most sensitive technique for the detection of vertebral metastases (T1-weighted images).

MRI of the entire spine and brain is recommended. Before the advent of MRI, conventional myelography and CT-myelography were the diagnostic procedures of choice. They remain as useful when MRI is not readily available or for patients unable to undergo MRI; i.e., those patients with severe scoliosis, ferromagnetic implants, programmable shunts, cardiac pacemakers, or severe claustrophobia.

MRI and myelogram have been the most preferred imaging modalities for spinal epidural tumors. Although contrast MRI is the preferred imaging modality by most surgeons, Monnard et al used MRI for localizing the tumor in only 65% of their patients.[14]

Within the spinal canal, the location of the tumor is usually dorsal, rather than ventral (Figures 3 and 4).[1,28] Mascalchi et al, in their series of eight cases, found a higher incidence of anterolateral location, but most of these cases had an associated vertebral body change, as well.[26] MacVicar et al have reported a lateral location of the tumor.[29] MRI appearance of PSEL was isointense on T1-weighted images and iso- to hyperintense on T2-weighted images, with marked contrast enhancement. The signal was homogeneous in all the sequences.[1,24] This is similar to the description by Negendank et al of lymphomas elsewhere in the body and the report by Li et al of spinal epidural lymphomas. There does not appear to be a change with differing grades of lymphomas.[13,30,31] Contrast enhancement helps us in better delineating the pathology (i.e., carcinoma, myeloma, and sarcoma). T2-weighted imaging often shows a higher signal than fat.[1,28] Occasionally, MRI demonstrates an extraradial component. This is due to infiltrative growth that mimics a nerve sheath tumor.[1]

Ho et al have described the F-18 fluorodeoxyglucose positron
emission tomography-computed tomography (FDG PET-CT) appearance of a primary epidural lymphoma as an intensely hypermetabolic soft-tissue mass in the epidural space.[32]

The differential diagnosis includes metastasis, epidural abscess, epidural hematoma, meningioma, neurofibroma, malignant peripheral nerve sheath tumors, tuberculosis, parasitosis, herniated disc, and leukemic masses.[26,33]

**SYSTEMIC WORKUP**

All the patients with a histological diagnosis of lymphoma need a complete systemic workup for lymphoma, without which a diagnosis of PSEL cannot be made. In the series by Monnard et al, whole-body CT scan was done in 77% of cases, bone marrow assessment in 96%, cerebrospinal fluid examination in 50%, lactate dehydrogenase measured in 84%, and white blood cell count in 94%.

**Recommendation of workup in PSEL[5,45]**
- Whole-body CT
- Craniospinal contrast MRI
- Bone marrow biopsy
- Bone scintigraphy
- Cerebrospinal fluid (CSF) examination

Chest CT remains the investigation of choice for detecting lung parenchymal and pleural involvement. Enlargement of the thymus and serial monitoring of the size of the thymus is possible with chest CT. Chest CT is often considered the imaging modality of choice for identifying chest wall involvement; however, MRI is thought to be more sensitive.[54]

Abdomen CT is usually used to rule in or out intra-abdominal involvement of lymphoma. Detection of splenic lymphoma with MRI is not reliable because both the normal spleen and lymphomatous tissue may have similar signal intensity. A CT obtained during the early phase of a bolus injection of contrast agent may show inhomogeneous enhancement that is suggestive of tumor infiltration.[34,35] With the availability of high resolution and dynamic CT, this imaging modality appears superior for assessing hepatic involvement. It is also helpful for diagnosing gastric, intestinal, pancreatic, and renal involvement.[54]

Gadolinium contrast MRI of the brain and spine is used to rule in or out central nervous system (CNS) involvement of lymphoma. Brain lymphoma involvement appears iso- or hypointense with both T1- and T2-weighted images.[36] Lymphomas may be seen in the brain parenchyma, meninges, spinal cord, and cauda equina.[34]

Bone marrow aspiration from the sternum or from iliac crest is essential to rule out lymphoreticular involvement. For the identification of bone/vertebral involvement of Hodgkin's disease, gallium-67 scintigraphy is associated with a sensitivity of greater than 93% and a specificity of 100%.[16,57]

A preoperative CSF examination through a lumbar puncture is not usually recommended unless myelography is required, because a lumbar puncture can precipitate the coning phenomenon. Other than a non-specific rise of protein levels, neoplastic cells are seldom identified with examination of the CSF.[34]

**PATHOGENESIS**

The etiology of lymphoma in the epidural space remains speculative. Drake et al and Blakslee et al have described what would have been most probable. They described the presence of lymphoid tissue along with the venous plexus in the epidural space which gives rise to lymphomas.[36,39] This hypothesis is convincing but has been criticized by Çağavi et al, who state that there is no evidence in the literature to support the same.[2] Although there has been a debate on the presence of lymphoid tissue in the epidural space, the fact that PSEL arises in the epidural space most certainly suggests the presence of lymphoid precursor cells in this location.[21]

Some authors are of the opinion that extradural “lymphoid rests” may give rise to the lymphoma in the epidural space. Epelbaum et al have noted reports showing evidence of lymphoid rests in the spinal epidural space.[2,14,16,19,60]

Primary lymphomatous involvement in the epidural space may be a result of spread from an unidentified “other” site. Such sites may include:
- Hematogenous spread from unidentified lymphatic sources.
- Direct spread from the vertebral bodies.[41,42] Even with the modern technological advancements, no diagnostic tool is considered both 100% sensitive and specific for identifying lymphoma either in blood or at any other site. Occult disease with hematogenous or contiguous spread is very feasible. On the other hand, patients who were diagnosed with PSEL and who had a negative workup for lymphoma have been diagnosed with extraspinal disease several years after the initial diagnosis.[5,13]

Another hypothesis is associated with the contiguous spread of the tumor from the paravertebral region to the epidural space through the vertebral foramen. In such cases, an area of increased attenuation on CT may be seen in the paravertebral region.[2,43] In the report by Mesfin et al and Iizuka et al, a lesion in the epidural space that was in continuity with the vertebral foramina was identified.[1,44]

**Histopathology and immunohistochemistry**

Histologically, most tumors are B-cell lymphomas of intermediate and high grade, although T-cell lymphomas and low-grade B-cell neoplasms are occasionally observed.[16,45] Seventy percent of the patients in the series reported by Epelbaum et al were of intermediate grade and the remaining 30% were high grade.[14]

Schwechheimer et al have found an increased occurrence of B-cell high-grade lymphomas in 11 of 19 cases, centroblastic lymphomas being the predominant type. There was only one
case of anaplastic plasmacytoma. Of significant note, they found no significant survival implications based on histopathological classification.\(^5\) Few other authors have found high-grade lymphomas occurring less frequently than the intermediate or low-grade lymphomas.\(^11,28,46\)

Haddad et al observed that the patients with the histopathologic subtype of mixed histiocytic lymphocytic lymphoma seemed to have a better survival than the other subtypes (61% at 10 years), but the small number (\(n = 17\)) of patients in this group did not allow statistical confirmation of this apparent observation.\(^19\)

Epidural lymphomas are either Hodgkin’s or non-Hodgkin’s type, the latter being more common. Primary Hodgkin’s lymphoma has been reported both in adults and in the pediatric age group.\(^5\)

Histopathologically, lymphomas have been classified by various authors. While describing PSELs, authors have used Rappaport, Keil or Revised European American Lymphoma (REAL) classifications, the latest being the WHO classification of lymphomas, initially published in 2001 and then updated in 2008. This is based on the REAL classification scheme.

A follicular center origin of the lymphoma was first described by Almeda et al in 2003 and similar origin but of diffuse variant was described by Mesfin et al in 2009.\(^1,17\) The diffuse follicular center variant found by Mesfin et al had a characteristic compartmentalizing sclerosis, surrounding the neoplastic cells, immunohistochemistry (IHC) positive for CD20, CD10, BCL-2 and BCL-6, and flow cytometry demonstrating light chain expression.\(^4\)

The Burkitt lymphoma observed by Daley et al, Mizugami et al, and Mora et al had characteristic starry sky appearance, with frequent mitotic figures and numerous tangible body macrophages. IHC was also consistent with Burkitt lymphoma and the DNA flow cytometry showed a diploid pattern with an S-phase of 27%.\(^30,31,23\)

Barnard et al have reported a case of mantle cell lymphoma, primarily arising in the spinal epidural space, with recurrence in the facial muscles, 7 months after subtotal resection. The histopathology and immunohistochemistry were suggestive of mantle cell lymphoma.\(^16\)

In the series by Rao et al, the mixed histiocytic lymphocytic type of lymphoma was encountered most frequently. All the survivors beyond 6 months were of the same subtype. They were, however, not able to draw significant conclusions as they did not have long-term follow-up.\(^12\)

**TREATMENT**

Collaboration of the surgeon, the radiotherapist, and the oncologist is strongly recommended in order to plan the course of management. The goals of treatment are pain relief, preservation or recovery of neurological function, and preservation of spinal stability.\(^24\) The literature emphasizes that delayed treatment has a deleterious effect on outcome. However, good functional outcome, with multimodality treatment, has been observed. Aggressive treatment is always advised.\(^21\)

**SURGERY**

Traditionally, surgery has been the first therapeutic approach in malignancies compressing the spinal cord. As lymphomas are very chemo- and radiosensitive tumors, surgery for metastatic lymphomas has most commonly been limited to spinal decompression and biopsy. The remainder of the lesion is addressed by radiation therapy and chemotherapy.\(^19\)

Aabo and Walbom-Jorgensen observed that the performance of a laminectomy was not associated with clinical improvement rates of previously known lymphoma patients with spinal cord compression.\(^48\) Similarly, Correale et al have stated that patients having laminectomy combined with chemotherapy and radiotherapy (favorable results in 5 of 9 patients) and patients having only chemotherapy and radiotherapy (favorable results in 11 of 21 patients) did not differ regarding prognosis.\(^49\)

In cases with PSEL in whom the diagnosis at the time of presentation is uncertain, surgical decompression in the form of partial or total removal of the tumor mass and/or decompressive laminectomy is indicated. Surgery in these instances immediately alleviates the spinal cord compression, as well as establishes the correct histological diagnosis.\(^15\) Most authors have opted for a treatment based on surgery, preferably laminectomy and excision/biopsy, followed by radiation therapy and chemotherapy.\(^17,19,28,60\) In growing children, a more conservative approach that is limited to laminotomy is suggested.\(^50\) In the study by Monnard et al, out of 52 patients, 48 (92%) underwent a laminectomy, with partial resection performed in 22 cases (42%) and complete resection in 7 cases (13%). At surgery, the lesion was brownish or reddish purple and soft to firm in consistency. It is usually not adherent to the dural sac.\(^51,5,20\)

**Radiation**

Radiation therapy (RT) alone as the adjuvant treatment (to surgery) has been considered in some series.\(^15,18\) Radiation doses used by various authors varied widely, with ranges between 20 and 60 Gy\(^5\) and doses of at least 25 Gy are recommended.\(^2,6,11\) Monnard et al, by their multivariate analysis, have advocated that a dose of at least 36 Gy at 2 Gy per fraction or its equivalent should be considered.\(^15\) They have also advised extending the field of irradiation to two or three vertebral segments—both above and below the tumor site and laterally to include the mediastinal and retroperitoneal lymph nodes in spinal lymphomas.\(^15\)

**CHEMOTHERAPY**

Most authors prefer to administer chemotherapy in conjunction with RT and not alone. It has been given before RT, after RT, sandwiched between, or administered concomitantly with RT. Oviatt et al have reported successfully treating two patients with
epidural NHL by chemotherapy alone. Various combinations of chemotherapeutic agents have been recommended, cyclophosphamide, vincristine, and prednisone (CVP) being an integral part of all the combinations. In the situation where the lymphoma was found to be of diffuse follicular type, the regime with rituximab, along with CVP, was found to improve the survival.

**COMBINED MODALITY TREATMENT**

Most studies have suggested that combined modality treatment, including RT and chemotherapy, seems to be the most efficient treatment for PSEL. Monnard et al observed local control of 88% and a 5-year overall survival of 69% with combined modality treatment. Among the 20 patients who received RT alone, 11 suffered a systemic relapse, 7 died, and 4 were alive of which 2 still had disease. Among the 32 patients who received a combined modality treatment, only 8 had a systemic relapse, 19 (59%) were still alive without disease 2–13 years after the treatment, and 5 had local relapse. In a multivariate analysis, they found that combined modality treatment was statistically superior to RT alone. Di Marco et al observed nine patients with PSEL and reported a long-term survival in two of them. They noted that they all had received RT, followed by a complete chemotherapy schedule. Epelbaum et al observed an actuarial 5-year survival rate of 66% using multimodality treatment. Rathmell et al reported a significant difference in actuarial survival between patients treated with radiation therapy alone (33%) and those with the combined modality (86%).

**OUTCOME**

In one of the earliest studies, reported by Rao et al, 9 of the 15 patients died within 6 months, while the 5 others had a short follow-up. Only one long-term follow-up, however, was available. Haddad et al observed that the patients with apparently localized primary epidural lymphoma had essentially the same survival at 5 years as those who had more readily detected tumors in other sites at the time of surgical treatment. Lyons et al reported a median survival of 42 months in a group of 10 patients. Samadian et al have reported a case of Hodgkin’s lymphoma with a good outcome and no evidence of local or systemic relapse at 7 years follow-up.

Patients with follicular center lymphoma were reported to have complete neurological recovery without disease progression after surgery and combined modality treatment at 4 and 12 months follow-up.

In the study by Mizugami et al, in which three children with sporadic primary epidural Burkitt’s lymphoma were reported, two of whom had widespread systemic relapse, including CNS involvement, and died at 7 and 20 months. The third child did not attain complete local control and had disease progression in spite of chemo- and radiation therapy and had a short survival of 3 months. Daley et al had found a total of seven cases of epidural Burkitt’s lymphomas in the literature including those reported by Mizugami et al, out of which six patients died of the disease with a mean duration of 8 months. They were of the opinion that this high short-term mortality might be a reflection of a less intensive approach in managing these cases. Mora et al reported five cases of pediatric PSEL, of which two were Burkitt’s lymphoma. Both had a fulminant course in spite of aggressive therapy. The other three patients were free of disease at 6, 10- and 12-year follow-up.

The patient with mantle cell lymphoma reported by Barnard et al underwent subtotal resection and RT. He, however, presented 7 months later with systemic relapse in the soft tissues of the face and mediastinal nodes. Two other patients with mantle cell lymphoma reported by Schwechheimer et al also had a shorter survival.

Monnard et al reported a post-treatment complete neurologic response in 25% of patients who had initial motor deficits. The remaining 75% had partial recovery. In their multivariate analysis, they have found that complete neurologic response was the most significant favorable prognostic finding with regard to overall survival. Eeles et al and Rathmell et al in their series also found that the outcome depends on the...
neurologic status after treatment.\textsuperscript{46,50} Salvati \textit{et al} were of the opinion that outcomes were influenced by preoperative neurological status and the use of combined treatments.\textsuperscript{17}

White \textit{et al} commented that patients with complete paraplegia before surgery have little or no chance of walking unaided after treatment.\textsuperscript{16} Many of these cases were reported before 1975. Others have more recently shown that even in such patients, good outcomes could be achieved. Haddad \textit{et al} observed 14 of 40 such patients did well after treatment.\textsuperscript{19} Tsukada \textit{et al} reported a complete recovery with surgery and multimodality treatment in a patient who presented with paraplegia.\textsuperscript{10}

In contrast to the poor prognosis for most patients with metastatic carcinoma, those with extradural spinal cord compression due to malignant lymphoma have a relatively good prognosis with respect to functional recovery and survival.\textsuperscript{12,19,29,30,46} It has been shown that patients presenting with spinal cord compression due to epidural metastatic disease had a longer survival than patients developing cord compression during the course of the disease.\textsuperscript{48}

**LOCAL CONTROL**

Monnard \textit{et al} reported local disease control after treatment in 88% of patients. In the remaining patients, in whom the disease progressed, the median time was 6 months.\textsuperscript{15} In their series, Rathmell \textit{et al} found an excellent local control of 88% at 10 years, with only two patients who could not attain permanent local control.\textsuperscript{50} One of them was treated with RT alone and had a relapse within the radiation field, 10 months after treatment. Another patient developed clinical evidence of recurrent spinal cord compression and had a residual paraspinal mass on X-ray with generalized disease. A further seven patients, all treated with RT alone, had systemic relapse without local failure. A variety of case reports have described local disease control at follow-up ranging from 4 months to 7 years.\textsuperscript{1,8}

**SYSTEMIC RELAPSE**

Monnard \textit{et al} observed 42% having systemic relapse, the commonest being in the lymph nodes (17%), followed by chest or abdomen, bone marrow, and CNS.\textsuperscript{16} Epelbaum \textit{et al} have reported in their study of 10 patients with spinal cord presentation of NHL, 7 achieved a complete remission after initial treatment. Four of them treated by combined modality treatment relapsed after a median time of 15 months, with relapses in the bone, the bone marrow, the CNS, and the mediastinum. The other three remained disease free. In the remaining three patients, the disease progressed while the patients were undergoing treatment.\textsuperscript{14}

**CNS RELAPSE**

Mackintosh \textit{et al} have studied 105 cases of NHL wherein they have found that patients with epidural lymphoma are at an increased risk for CNS relapse.\textsuperscript{57} However, in these studies, majority of the patients had disseminated lymphoma. Whether the same risk of CNS relapse is carried by the patients with PSEL is yet to be confirmed by larger series with longer follow-ups.

Monnard \textit{et al}, in their series, have given intrathecal methotrexate as CNS prophylaxis in 10 of 52 patients.\textsuperscript{15} None of these patients had CNS relapses. Four of the remaining 42 patients, who did not receive CNS prophylaxis, had CNS relapse. In the cases reported by Mizugami \textit{et al} two of the three patients had CNS relapse with early mortality.\textsuperscript{31}

**PROGNOSTIC FACTORS**

Only the study conducted by the Rare Cancer Network has commented about the prognostic factors. They found that gender did not determine the outcome. They found that younger individuals with an age less than 63 years had a significantly improved overall survival and disease-free survival. However, in this study younger patients were treated more aggressively both with radiation therapy and chemotherapy.\textsuperscript{15} Radiotherapy volume more than focal, total radiotherapy dose (>36 Gy), and combined modality therapy influenced overall survival ($P = 0.001, 0.01,$ and 0.005, respectively), by multivariate analysis.\textsuperscript{15} Grade of the tumor, whether low, intermediate, or high, did not seem to influence prognosis.\textsuperscript{15}

Although the Rare Cancer Network study did not demonstrate a difference based on the grade of the tumor, the patients diagnosed with Burkitt’s lymphoma had a worse outcome in all the reports except one.\textsuperscript{16,20,21,23} Patients who experience systemic/CNS relapse have a worse prognosis than that observed in the studies by Rare Cancer Network and Mizugami \textit{et al}.\textsuperscript{15,23}

Lakshmaiah \textit{et al} have found poor response in patients who had longer duration of neurological deficit prior to treatment.\textsuperscript{36}

**PROPOSED TREATMENT PROTOCOL**

A proposed treatment protocol by the authors is as provided in Figure 5. Preoperative steroids are advised, but in the immediate post-operative period steroids should not be discontinued despite knowing the fact that they might alter the staging picture.\textsuperscript{30} Intrathecal prophylaxis is observed to possibly be beneficial, but there are no randomized trials to support the data.\textsuperscript{15}

**CONCLUSIONS**

It is emphasized that PSEL is a potentially curable disease with good clinical outcome when treated with surgery and multimodality treatment. With the advancing technology, accurate and early diagnosis of this entity, with a complete workup, has been possible. The role of surgery in PSEL is clear. When the diagnosis is not yet established, surgery is clearly indicated. Chemotherapeutic regimes and present day precise delivery techniques of radiotherapy act as the key disease control...
measures. Adequate physical therapy and intense rehabilitation is of prime importance for functional recovery. A favorable outcome can be expected in patients with PSEL, if diagnosed and treated early, unlike secondary spinal epidural lymphoma that has a poor outcome.

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