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Ossification of yellow ligament-lesser known common cause of thoracic myelopathy in Indian subcontinent treated surgically

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ABSTRACT

Background: To undertake a study which outlines the clinical and radiological features of ossification of yellow ligament (OYL) causing thoracic myelopathy (TM) in Indian subcontinent, to assess the outcomes of surgical resection of yellow ligament and compare different preoperative factors that contribute to be a risk factor in the overall post-surgical recovery rates (RR).

Methods: A retrospective analysis of prospectively collected data from a cohort of 45 patients who visited our spine OPD from January 2012 to December 2019 who underwent surgical decompression for TM due to OYL was studied. The surgical outcomes and RR were calculated, compared and pre operative risk factors which could possibly be involved in giving poorer RR were analysed.

Results: Our study included 45 patients who underwent surgical resection of OYL for TM. On comparison of post operative improvement in myelopathic symptoms, pre-operative mJOA score of 4.56 had increased significantly to 7.83 at 2 years follow up. While the majority (80%) of patients had an excellent and good recovery rate while 16% of patients had a fair recovery rate and 4% had no change at all in comparison to pre-operative mJOA scores. Preoperative risk factors for poor outcomes were also analysed.

Conclusions: Early and timely before the onset or progression of any neurologic involvement. The pre operative risk factors which could give guarded prognosis and lower RR are, the presence of intramedullary signal changes (myelomalacia), >6-10 months of progressive pre operative symptoms and an mJOA<5.

Keywords: Thoracic myelopathy, Ossification of yellow ligament, Risk factors, Decompression, Surgical outcomes

INTRODUCTION

Thoracic myelopathy (TM) is a fairly uncommon spinal disorder seen in patients secondary to various degenerative spinal pathologies like thoracic prolapsed intervertebral disc(PIVD), posterior osteophytes, ossification of posterior longitudinal ligament (OPLL) and ossification of ligamentum flavum/OYL.[1-5] With growing using of diagnostic tools such as computed tomography (CT) and magnetic resonance imaging (MRI), OYL is now better diagnosed as a major cause of progressive TM.

The ligamentum flavum is an elastic connective tissue within the spinal canal and it is divided into 2 parts, capsular and interlaminar.[6] It has 2 layers a superficial layer with crisscross fibres and deep layer with vertical fibres. At each intervertebral segment it attaches to the ventral aspect of the cranial lamina and dorsal aspect of the caudal lamina, it extends laterally from the midline to the intervertebral foramen forming the superior-posterior margin of the foramen, it turns dorsally outside the foramen to fuse with the capsule of the articular facets.[7,8] OYL commonly involves the lower thoracic spine (T9-T12) and next being the upper thoracic spine (T1-T4).[9-11]

Thoracic OYL is reported in several Asian countries such as Japan, China and South Korea.[10,12-14]

Only few studies on Indian population are reported in literature. Compressive TM due to OYL is usually progressive and refractory to conservative management. Surgical management with posterior thoracic laminectomy with/without fusion is always mandated. However, surgical outcomes vary, despite good surgical decompression as RR varies from 25-100%.[9,15,16] This study is aimed at studying various preoperative and perioperative clinical and radiological parameters and postoperative RR and factors affecting the RR in patients undergoing surgical management for TM due to OYL.

METHODS

A retrospective analysis of prospectively collected data from a cohort of 45 patients who visited our spine OPD in Bombay hospital and medical research institute from January 2012 to December 2019 who underwent surgical decompression for TM due to OYL was studied. This study was conducted in a single institution and all cases were operated by a single surgeon. All patients in this study signed an informed surgical consent and were informed beforehand that their data could be used in the future for research-oriented purposes. No institutional review board approval was taken for this study as all data collected was part of routine diagnosis and treatment without the use of any experimental trial. Clinical and radiological parameters were used for diagnosis of TM. Patients presenting with typical clinical features associated to TM including back pain, progressive weakness in the lower limbs with gait imbalance, paraesthesia, sensory deficits in the lower limbs, bowel/bladder dysfunctions, increased lower limb muscle tone with pathological deep tendon reflex were included. All patients underwent MRI and 3D CT scans of the thoracolumbar spine with whole spine screening scans.

Demographic data (Table 1) like age, sex, body mass index (BMI), smoking status, alcohol consumption, preoperative duration of myelopathy symptoms, preoperative severity of myelopathy (using lower limb, trunk, bladder scores of modified Japanese orthopaedic association (mJOA) score (Table 2), intramedullary signal changes on MRI (T2 hyperintense/ T1 isointense or hypointense) (Figure 3 A and B), type of OYL on MRI sagittal and axial CT scans, number of levels of OYL, Dural ossification (DO) were documented. Radiological workup confirmed the level of OYL. Two types of OYL were studied on sagittal MRI (i) beak type (ii) round type (Figure 1 A and B). Depending on pattern of ossification in axial CT scans three types of OYL were seen (i) unilateral ossification (ii) bilateral ossification (iii) bridged ossification (Figure 2 A-C).

Inclusion criteria

Patients presenting with back pain or neurological symptoms with radiological diagnosis of OYL in MRI/CT. Age group 35-78 years, patients compliant to undergo surgical management and patients medically fit to undergo surgical management were included in the study.

Exclusion criteria

TM patients with thoracic OYL with coexistent thoracic OPLL, thoracic prolapsed intervertebral disc, patients with compressive cervical myelopathy, history of spine tumours (causing cervical/ TM, previous surgeries for TM and patients with tandem cervical or lumbar spinal canal stenosis were excluded from the study.

Surgical technique

All surgeries performed under general anaesthesia. Patients were positioned on a radiolucent table in prone position with bolsters underneath to keep the abdomen free, head end raised and pressure points well padded, to avoid ischemic injury to an already myelopathic cord the mean arterial blood pressure (BP) was maintained >70 mmHg and systolic BP>100 mmHg. Under fluoroscopic guidance the thoracic spine level to be operated was identified and surface marking done. Appropriate size midline skin incision, subperiosteal dissection was performed laterally extending to tip of the transverse process on both the sides. All surgeries performed under microscopic vision. Using high speed burr with continuous normal saline irrigation 2 bony gutters were created at the spino-laminar junction on each side. Nerve hooks and 1 mm Kerrison roenger used to complete the laminotomy on each side. The entire central chunk of spinous process the lamina with the underlying ossified ligamentum flavum is slowly released from the underlying dura using nerve and blunt dissection with Penfield dissector. In patients with Dural ossification no attempts were done to excise the ossified the dura, instead wide laminectomy performed piece meal and ossified ligametum flavum adherent to calcified dura were released from all sides and left afloat (Island decompression). Pedicle screw fixation was performed in those cases with >3 level laminectomy, greater than half of facet joint disrupted on both sides, at cervicothoracic and thoracolumbar junction. Dural tear was encountered in 4 cases out of which in 3 cases the Dural repair was done with 4-0 proline suture and in 1 case repair was not possible sealants like gel foams and fibrin glue were used to seal of the Dural tear and water tight wound closure was performed in all cases of Dural tear and postoperatively gravity assisted drain not removed until total collection in 24 hours is less than 50 ml. Optimal decompression (Figure 4). In bed turning and sitting allowed on the same day, in patients with Dural tear head neutral bed position and minimal mobilization allowed till drain removal. In rest all patient’s aggressive lower limb physiotherapy started from postoperative day 1.

Intraoperative parameters like duration of surgery, blood loss, duration of stay in hospital (Table 1), complications like Dural tear, postoperative transient neurological worsening, surgical site infections documented (Table 3).

Follow up period

All patients were followed up at 3 months, 6 months, and 1 year and every half year beyond the first year after surgery for a minimum of 2 years. During the follow-up postoperative neurological outcomes were evaluated using modified JOA score of TM (Table 2). 2^{nd} year follow up JOA score was considered as final postoperative JOA score and recovery rate was calculated as

Recovery rate =(post-operative JOA-pre-operative JOA/ 11-preoperative JOA)×100

Outcomes were defined as excellent (RR=75%-100%), good (RR=50%-74%), fair (RR=25%-49%), no recovery (RR=0%-24%) and worsening (RR less than 0).

Statistical analysis

IBM SPSS software was used to perform all analysis. Chi-square test was used to compare categorical variables between two and three groups. Student's t tests for 1/2 groups and ANNOVA test for more than 2 groups was used and one-way analysis of variance done to compare the statistical significance of the association for continuous data. Pearson's and Spearman's rank correlation coefficients were used to test the correlations between various factors and RR. Multiple regression analysis was performed to identify the independent factors associated with RR. Results are expressed as the mean ± standard deviation, with $p<0.05$ considered statistically significant.

RESULTS

The study group consisted of 45 patients with 29 males and 16 females with mean age of 54.6 years (37-77 years). A total of 15 patients were diabetic, 15 alcoholics with average BMI of 26.2 kg/m^2 (17.7-30.4). Average duration of symptoms to surgery was 9 months (2-17 months). Level of OYL was distributed with 16 (35.6%) patients having upper thoracic OYL, 8 (17.8%) middle thoracic, 21 (46.7%) lower thoracic spines. Morphology of OYL on sagittal MRI showed 15 (33.3%) patients with beak type of OYL and 30 (66.7%) patients with round type OYL. Axial CT scans showed 12 (26.7%) unilateral, 10 (22.2%) bilateral and 23 (51.1%) bridged types of OYL morphology. Dural ossification seen in 10 (22.2%) patients. Intramedullary signal changes (T2 hyperintensity/T1 iso-hypo intensity) indicating myelomalacia (cord edema/cystic changes) seen in 15 (33.3%) patients.

Mean preoperative JOA score was 4.56 (1-8). Wide posterior decompression laminectomy without instrumentation was done in 38 patients and decompression with instrumentation was done in 7 patients. In all 10 patients with Dural ossification island decompression performed resulting in minimal Dural manipulation and significantly lower rates of intraoperative Dural tear and CSF leak. Average duration of surgery is 136.28 min (100-180 min) with average intraoperative blood loss of 240.12 ml (100-400 ml). Total duration of hospital stay is 5.49 days (4-8 days). All patients were followed up for a minimum period of 2 years, average follow-up duration being 48.6 months (24-68 months). Four patients had intraoperative Dural tear and CSF leak of which in 3 patients Dural tear repair with 4-0 proline sutures was performed and CSF leak controlled and in 1 patient were Dural repair was not feasible because of the rugged nature of tear and anterolateral position gel foams and neuro patties were used to control the CSF leak and then sealed with fibrin glue. Water tight wound closure with gravity assisted subfascial drain was placed in all 4 cases and minimal mobilization protocol followed postoperatively and drain removed only after 24 hours CSF collection is less than 50 ml. No patients had complications of wound dehiscence, meningitis, CSF pseudocyst formation in subsequent follow-up. Three patients had postoperative neurological worsening of which 2 patients recovered in 48 hours with intravenous methylprednisolone, 1 patient did not recover and had complete postoperative paraplegia. Potential causes being ischemic reperfusion cord injury, microthrombi, internal recoil of the spinal cord following decompression. Superficial wound infection was seen in 3 patients which was managed with intravenous antibiotics and regular sterile dressing and 1 case needing debridement.[18] Five patients had urinary tract infection (UTI) which was managed with oral antibiotics and perineal hygiene (Table 4). Average postoperative JOA score at 2 year follow up is 8.02 (1-11) and average RR being-57.7%, with-40% having excellent, 40% good, 4.44% fair, 15.5%-no change in recovery and 0.02% postoperative radiological worsening, 64.44% patients had greater than 50% RR.

Figure 1 (A and B): Morphology of OYL on sagittal MRI films beak type round type.

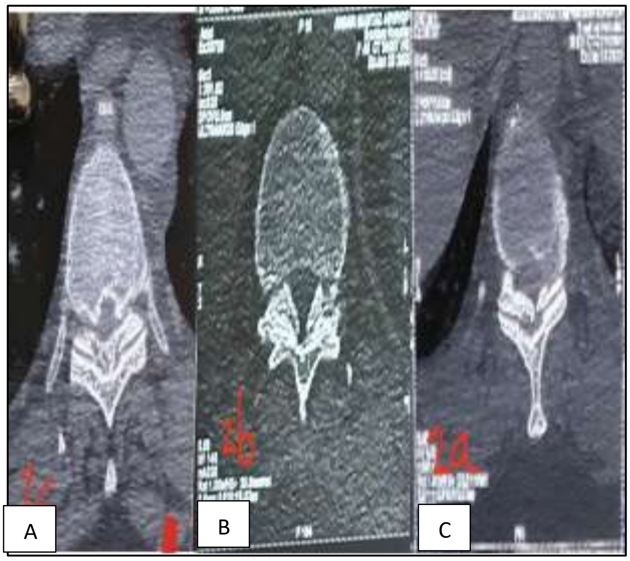

Figure 2 (A-C): Morphology of OYL on axial CT scans. Unilateral, bilateral and bridged.

Figure 4: Intraoperative wide posterior laminectomy with excised calcified ligamentum flavum.

Figure 3 (A and B): Intramedullary signal changes on MRI. T2 hyperintensity and T1 iso-intensity.

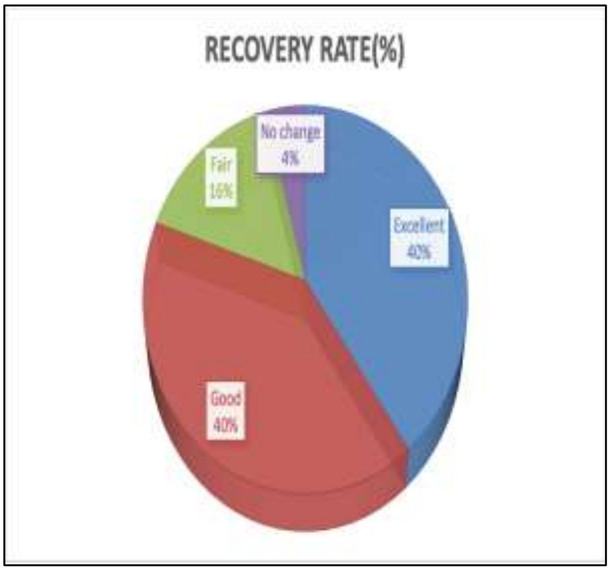

Figure 5: RR (%) in the OYL patients treated surgically.

Table 1: Demographic data.

Variables	Value (Mean, Range)
Age (in years)	54.67 (37-77)
Sex (M/F)	29/16
BMI (kg/m^2)	26.23 (17.7-30.4)
Alcohol, number (%)	37.8
Current smoking (%)	33.4
Pre op symptoms duration (Months)	9 (2-17)
Pre-op (JOA) score	4.56 (1-8)
1 year (JOA) score	6.87 (1-11)
2-year (JOA) score	7.83 (1-11)
Operative time (min)	136.28
Intraoperative blood loss (ml)	240.12
Days of hospitalisation (days)	5.49 (4-8)

Table 2: Modified JOA score for TM.

Variables	Score
Motor function: lower extremity	
Unable to stand up and walk by any means	0
Able to stand up but unable to walk	0.5
Unable to walk without a cane or other support on a level	1
Able to walk without support but with a clumsy gait	1.5
Walks independently on a level but needs support on stairs	2
Able to walk independently when going upstairs, but needs support when going downstairs	2.5
Capable of fast but clumsy walking	3
Normal	4
Sensory function: lower extremity	
Complete loss of touch and pain sensation	0
50% or less normal sensation and/or severe pain or numbness	0.5
More than 60% normal sensation and/or moderate pain or numbness	1
Subjective numbness of slight degree without any objective sensory deficit	1.5
Normal	2
Sensory function: trunk	
Complete loss of touch and pain sensation	0
50% or less normal sensation and/or severe pain or numbness	0.5
More than 60% normal sensation and/or moderate pain or numbness	1
Subjective numbness of slight degree without any objective sensory deficit	1.5
Normal	2
Bladder function	
Urinary retention and/or incontinence	0
Sense of retention and/or dribbling and/or thin stream and/or incomplete continence	1
Urinary retardation and/or pollakiuria	2
Normal	3
Total score	11

Table 3: Comparison of each factor in corelation to postoperative RR by means of univariate statistics.

Factors	Classification	RR, T test result		Test value	P value
		Mean	SD		
Gender	Male	54.97	25.94	-0.686	0.496
	Female	60.88	30.59		
Diabetes mellitus	Yes	58.79	27.3	0.485	0.63
	No	54.72	28.3		
Smoking history	Yes	64.4	23.16	1.273	0.21
	No	53.41	29.08		
Alcohol consumption	Yes	50.05	27.94	-1.348	0.185
	No	61.34	26.8		
Type of OYL (Sagittal MRI)	Beak	75.87	13.98	3.676	0.001**
	Round	47.67	27.89		
Dural ossification	Yes	48.93	24.72	-1.064	0.293
	No	59.4	28.12		
Myelomalacia in MRI	Yes	24.64	15.86	-10.31	0.000***
	No	73.29	14.45		
Surgical procedure	Decompression	59.31	25.25	1.285	0.206
	Decompression+ fusion	44.9	37.46		
BMI (kg/m^2)	25 and below	50.03	27.7	-1.222	0.228
	> 25	60.59	27.15		
Age (In years)	50 and less	55.16	32.28	0.201	0.819
	51-60	55.49	25.81		
	Above 60	61	23.55		
Type of axial scan	BL	56.24	23.43	0.031	0.969
	BR	58.08	31.1		
	UL	55.82	25.17		

Continued.

Factors	Classification	RR, T test result		Test value	P value
		Mean	SD		
OYL level	Lower thoracic	58.79	28.44	0.152	0.86
	Mid thoracic	52.38	20.85		
	Upper thoracic	57.16	30.3		
Pre-op symptom duration (Months)	<5	70.17	13.77	77.852	0.00**
	5-10	73.91	14.77		
	>10	16.42	14.00		
Pre op mJOA	<5	41.30	29.12	-3.22	0.002**
	5 and more	67.95	26.27		

*P value significance, more than 2 group comparison therefore ANOVA is used.

As p value for t test is less than that of 0.05 indicates significance of difference and the average score of outcomes is significantly less in < five pre-operative (JOA) score group than 5 and more. As p value for t test is less than that of 0.05 indicates significance of difference and the average score of outcomes in round type of OYL (sagittal) is significantly less than beak type of OYL (sagittal). As the p value for t test is less than that of 0.05 indicates significance of difference as well as the average score in myelomalacia changed is significantly less than that of those with the no myelomalacia. As p value for the t test is less than that of the 0.05 indicates significance of the difference in between groups of pre-operative symptoms duration, with group with >10 months duration of symptoms having significantly lower outcomes.

Factors affecting surgical outcome

Age, sex, smoking, DM, alcohol, sagittal/axial configuration of OLF, Dural ossification, instrumented surgical decompression didn't have statistically significant correlation with RR (p>0.05), whereas preop duration of symptoms, axial configuration of OLF, intramedullary signal changes on MRI and preop JOA score indicating severity of myelopathy correlated significantly with RR (p<0.05) done with univariate analysis. Regression analysis also performed, compared to RR. Regression analysis showed poor RR with significant association in patients with intramedullary signal changes (Myelomalcia) on MRI shows parameters as important predictors of surgical outcomes (p<0.05) (Table 5).

Table 4: Associated complications.

Complications	N	Percentage (%)
Dural tear	4	8.89
Transient neurological deficit	3	6.67
Superficial wound infection	4	8.89
Urinary tract infection	5	11.11

Table 5: Regression analysis in comparison to outcome (RR).

Variables	Unstandardized coefficients		T	P value	Interpretation
	B	Std. error			
Constant	-81.182	34.179	-2.375	0.022	
Pre-op symptoms duration (months)	2.219	1.266	1.752	0.087	Non-significant
Pre-op (JOA) score	0.189	1.551	0.122	0.904	Non-significant
Myelomalacia (present/absent)	73.487	12.457	5.899	0.000	Significant
Type of OYL (sagittal)	-4.677	5.175	-.904	0.372	Non-significant

Unstandardized coefficients for myelomalacia are positive and significant indicates that without myelomalacia the outcome increases significantly.

Table 6: Surgical outcomes compared at all follow up (Paired t test result).

Variables	T test value	Df	P value
Pre-p (JOA) score -1-year (JOA) score	-9.481	44	0.000
Pre-op (JOA) score-2-year (JOA) score	-13.786	44	0.000

Interpretation

P value of paired t test is less than that of 0.05 indicates significance of difference between preoperative mJOA score and mJOA score at final follow up.

DISCUSSION

Thoracic OYL is an uncommon entity and usually asymptomatic. Usually, the disease progress gradually and has an insidious onset eventually leading to myeloradiculopathy. Review of published literature shows mean age of symptomatic TM due to thoracic OYL is

50-60 years.[9,18,19] Our study group also had a mean age of 54.67 years. Literature provides mixed findings in regards to the incidence among different gender groups with some studies showing higher prevalence in males and rest showing higher prevalence in females.[12,19,20] We did not find any statistically significant difference in prevalence among male/female. OYL not only occurs in isolated form but can also be coexistent with other metabolic pathologies like DISH, ankylosing spondylitis, Pagets disease, hypoparathyroidism and X-linked hypophosphatemia.[21,22] Very little is known about the pathophysiology of OYL with various studies describing the possible pathologies like mechanical/traumatic[23,24], metabolic[25], chronic degenerative, biological/hereditary, environmental and genetic factors in the development and progression of OYL.[25-30] Published literature shows lower thoracic spine as the most commonly affected segment, similar results were found in our study.[19,21,22,31] Literature regarding the level of OYL shows that mobile cervical and lumbar segments are less vulnerable than the fixed thoracic spine.[16,32,33] Lower thoracic spine level with kyphotic spinal alignment with a strong traction force tends to act on the ligamentum flavum due to rotational flexion movement of the thoracolumbar spine because it locates far from the centre of movement, this traction force is thought to influence the ossification mechanism.[34,35] In contrast, within the ligamentum flavum at the cervical and lumbar spine with lordotic spinal alignment, not ossification but calcification without trabecular structure tends to be formed. The development of OYL is likely a result of endochondral ossification.[36] There are 2 layers of ligamentum flavum: the interlaminar portion over the central part and the lateral capsular portion.[36] Ossification is usually initiated in the capsular portion but may progress to the interlaminar area.[6] The ossification then progresses ventrally to compress the spinal cord. If the ossification occurs bilaterally, the bony mass will then fuse in the middle and thicken to form a central tuberous mass.[6] In the sagittal plane, ossification begins at the site of attachment caudally along the superficial layer of the ligamentum flavum and then progress cephalo-anteriorly, thus indicating the unilateral, bilateral and bridged course of formation of OYL in axial CT scans.[36]

Clinical characteristics

OYL compresses the spinal cord from the dorsal aspect leading to symptoms. Thoracic OYL patients show typical features of TM like sensory and motor disturbances in the trunk and lower limbs, gait imbalance, exaggerated deep tendon reflexes especially in lower limbs when compared to upper limbs and sphincter disturbances. Clinical presentation of patients can be in 2 forms (i) most commonly seen as insidious onset of symptoms of TM usually indicating a chronic cord compression (ii) acute myelopathy usually after an incident of trivial trauma usually indicating a sudden compromise in already stenotic spinal canal due to hematoma/edema. MRI is the modality of choice for diagnosis, screening of entire spinal cord is mandatory to avoid missing the affected level and also to detect coexistent spinal lesion in cervical /lumbar spine which is not uncommon. Conservative treatment has proven to be ineffective for symptomatic patients of thoracic OYL.[33,37,38] Surgery is the only treatment that can adequately address the significant compression of neurologic structures by OYL.[37-39] The aim of surgical intervention is to excise the ossified segments and provide adequate decompression. Posterior decompression is the most commonly reported surgical method and total laminectomy is the most commonly used means of achieving such decompression. The extent of decompression used differs in various reports and most surgeons consider that the extent of decompression should include the medial 1/3rd to ½ of the facet joint and one or possibly 2 laminae superior and inferior to the diseased segment.[16,22,33,41] All patients in our study received posterior decompression laminectomy. The mean recovery rate was 57.07% which is comparable to previous literature.[2,9,16,22] Use of spinal fusion to treat TM caused by OYL is controversial. In our study posterior laminectomy combined with spinal fusion with instrumentation was performed in 7 patients (15.5%). No instability or proximal kyphotic deformity was seen at the final follow-up.

Prognostic factors

Many previous published literatures shows younger the age of onset of TM due to OYL better the prognosis.[37,42,43] Kojima reported good postoperative recovery in younger patients despite severe involvement indicating good plasticity of spinal neurons.[44] But in our study no such correlation was seen. Given to the fact that the disease is very rare in young patients. No study has reported correlation between sex and recovery rate. Preoperative neurological status correlates with age indicating progressive nature of the condition with old age, sex has no correlation with preoperative neurological status.

Preoperative duration of symptoms

Preoperative duration of symptoms correlates significantly with recovery rate, thus indicating the importance of early diagnosis and surgical decompression for achieving a good outcome. Published studies support our observation and few other studies also state otherwise.[9,10,37,43,45] The latter observation may be due to delayed surgical intervention leading to irreversible cord damages causing poor recovery or because of a smaller sample size. In our study patients were operated as early as 10 days of onset of symptoms to as late as 24 months from onset of symptoms, thus having a wide range. This shows that preoperative duration of symptoms could be considered a predictor of surgical outcome.

Preoperative severity of myelopathy

Low preoperative JOA score has adverse influence on recovery rate indicating importance of early surgery before developing significant functional impairment. Published papers support the finding but a few other studies also record otherwise.[10,37,42,43] This difference could be attributed to use of different scales for neurological assessment like Nuricks scale and ASIA scale by various published papers. It is difficult to compare the results in our study which shows significant correlation between preoperative JOA score and recovery rate making it a predictor of surgical outcome. But individual parameters of the JOA score and their recovery patterns were not studied.

Morphology of OYL

OYL morphology in sagittal scans had no correlation with RR. But OYL morphology in axial scans had correlation with RR and round type ossification involving the whole canal had a significantly poorer outcome in comparison to Beak type. This shows the progression of OYL from lateral to medial and eventually encroaching the whole of the spinal canal, indicating the chronicity of the disease.

Number of segments involved in OYL

Kawaguchi et al reported OYL affecting more than 2 segments as predictor of poor outcome, while all other studies including ours, do not find number of segments as having any impact on recovery.[9,10,43,45] Takei et al found midthoracic involvement as having negative influence on recovery, while others agree with us as level having no influence on recovery.[9,10,43,45] Preoperative number of segment involvement does not correlate with number or level of OYL.

Intramedullary signal changes

Fifteen patients had intramedullary signal changes (ISC) in the form of T2 hyperintensity and T1 iso-intensity/hypo-intensity and our study shows it has negative influence on RR. Literature supports this-findings.[9] Follow-up MRI in some patients showed reduction in ISC but no correlation was seen between reduction and RR. Study shows T1 hyperintensity and T2 hyperintensity indicating cystic change having negative influence on recovery as compared with iso-intensity in T1 and T2 hyperintensity indicating cord edema and inflammation.[43]

Complications

Dural tears and CSF leakage are the most common complications of thoracic OYL surgery and lead to CSF pseudocyst, respiratory obstruction, wound dehiscence and meningitis.[46,47] Miyakoshi et al reported that Dural adhesion was observed in 62% of the 34 patients with OYL and found that Dural adhesions was frequently observed in larger types of OYL.[42] Aizawa et al reported that 9 of 72 patients with OYL had Dural tears during surgery and 8 of them had DO.[7] Ben Hamouda et al reported incidence of Dural tears as being 22%.[33] In our study 10 (22.2%) patients had Dural ossification and Dural adhesions, 4 (8.8%) patients had Dural tear and leak. The island decompression technique followed in such cases resulted in reduced Dural manipulation and in turn significantly reduced the incidence if Dural tear and leaks in our study.

Limitations

Our study is a retrospective unrandomized cohort study. Patients of thoracic OYL are often associated with coexisting spinal disorders like OPLL, thoracic PIVD, coexistent cervical and lumbar canal stenosis which were not included in the study which otherwise would have made the surgical decision more complicated and the surgical outcome more unpredictable. Large scale prospective investigation on the predictive factors for poor surgical outcomes in thoracic OYL surgery will be necessary in the future.

CONCLUSION

Thoracic OYL is a relatively common entity causing TM. Early diagnosis and surgical decompression with knowledge about the disease and educating the patient about negative prognostic factors like preoperative duration of symptoms, preoperative JOA score, ISC (Myelomalacia) are the important key factors to better surgical outcomes, recovery and patient satisfaction. Dural ossification is the most common entity causing Dural tears and CSF leaks within these surgeries. A safe Island decompression is recommended to reduce the incidence of same.

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