ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Infection

Editor
Ali Akhaddar, MD, IFAANS
Avicenne Military Hospital, Marrakech, Morocco

SNI
Open Access

Case Report

Spinal intramedullary abscess due to *Candida albicans* in an immunocompetent patient: A rare case report

Paulo Eduardo Albuquerque Zito Raffa[1], Rafael Caiado Caixeta Vencio[2], Andre Costa Corral Ponce[3], Bruno Pricoli Malamud[3], Isabela Caiado Vencio[4], Cesar Cozar Pacheco[5], Felipe D'Almeida Costa[6], Paulo Roberto Franceschini[7], Roger Thomaz Rotta Medeiros[5], Paulo Henrique Pires Aguiar[8]

[1]Department of Medicine, Catanduva Medical School (FAMECA-UNIFIPA), Catanduva, São Paulo, [2]Department of Medicine, Pontifical Catholic University of Goiás, Goiânia, [3]Department of Medicine, Faculty of Medicine of ABC, Santo André, São Paulo, [4]Department of Medicine, School of Medicine of Pontifical Catholic University of São Paulo, Sorocaba, São Paulo, [5]Department of Neurosurgery, Santa Paula Hospital, São Paulo, [6]Department of Pathology, DASA, São Paulo, [7]Department of Neurology and Neurosurgery, University of Caxias do Sul, Caxias do Sul, Rio Grande do Sul, [8]Department ofMedicine, Division of Neurology, Catholic Pontifical University of São Paulo, Sorocaba, São Paulo, Brazil.

E-mail: *Paulo Eduardo Albuquerque Zito Raffa - pauloeduardoazr@gmail.com; Rafael Caiado Caixeta Vencio - rcvencio@gmail.com; Andre Costa Corral Ponce - andre.ponce@aluno.fmabc.net; Bruno Pricoli Malamud - bruno.malamud@gmail.com; Isabela Caiado Vencio - belacvencio@gmail.com; Cesar Cozar Pacheco - cesarpacheco.md@gmail.com; Felipe D'Almeida Costa - felipedalmeida@yahoo.com.br; Paulo Roberto Franceschini - prfrance@yahoo.com.br; Roger Thomaz Rotta Medeiros - roger.rotta@hotmail.com; Paulo Henrique Pires Aguiar - phpaneurocir@gmail.com.

***Corresponding author:**
Paulo Eduardo Albuquerque Zito Raffa,
Catanduva Medical School (FAMECA-UNIFIPA),
Catanduva, São Paulo, Brazil.

pauloeduardoazr@gmail.com

Received : 30 April 2021
Accepted : 18 May 2021
Published : 14 June 2021

DOI
10.25259/SNI_435_2021

Quick Response Code:

ABSTRACT

Background: A spinal intramedullary abscess is a rare clinical entity in which patients classically present with a subacute myelopathy and progressive paraplegia, sensory deficits, and/or bowel and bladder dysfunction. We report the second case of spinal intramedullary abscess caused by *Candida albicans* to ever be published and the first case of its kind to be surgically managed.

Case Description: A 44-year-old female presented with severe lumbar pain associated with paraparesis, incontinence, and paraplegia. She reported multiple hospital admissions and had a history of seizures, having already undergone treatment for neurotuberculosis and fungal infection of the central nervous system unsuccessfully. Nevertheless, no laboratory evidence of immunosuppression was identified on further investigation. Magnetic resonance imaging showed a D10-D11, well-circumscribed, intramedullary mass within the conus, which was hypointense on T1-weighted imaging and hyperintense on T2/STIR weighted. The patient underwent surgery for removal and biopsy of the lesion, which provided the diagnosis of an intramedullary abscess caused by *C. albicans*, a very rare condition with only one case reported in literature so far.

Conclusion: *C. albicans* intramedullary abscess is a very rare clinical entity, especially in immunocompetent patients. We highlight *C. albicans* as an important etiology that must be considered in differential diagnosis. Critical evaluation of every case, early diagnosis, timely referral and surgical management of the abscess is essential to improve neurological outcome.

Keywords: Abscess, *Candida albicans*, Central nervous system, Conus medullaris, Intramedullary

INTRODUCTION

Involvement of the central nervous system (CNS) by *Candida* sp. usually leads to meningitis and cerebral microabscesses, especially in immunocompromised individuals or when anatomic barriers are breached by surgery or implanted devices.[17] However, CNS involvement in

immunocompetent patients represents an even rarer entity.[7] To the best of our knowledge, *Candida albicans* intramedullary abscesses had only been reported once in an immunocompetent who did not need neurosurgery.[39] Here, we report a cauda equina *C. albicans* intramedullary abscess, representing the second report in literature and the first case approached surgically.

CASE REPORT

A 44-year-old female patient sought the neurosurgery service at Hospital Santa Paula with a complaint of lower back pain associated with paraparesis for 2 years with progressive worsening of the condition between crises. She reported development of paraplegia in the past year.

In an investigation of multiple hospital admissions, she previously underwent treatment for CNS fungal infection and neurotuberculosis in late 2020 with amphotericin B (for 6 weeks) followed by voriconazole (for 4 weeks) with an ineffective result. The cerebrospinal fluid (CSF) contained 43 cells (75% lymphocytes, monocytes 22%, macrophages 3%), protein 175 mg/dL; glucose 26 mg/dL; lactic acid 42 mg/dL; lactate dehydrogenase 30 U/L; adenosine-deaminase 6.2 U/L; gamma globulin 31.62%; microbiology negative; antibodies for syphilis, *Borrelia burgdorferi*, toxoplasmosis, cytomegalovirus (CMV), herpes simplex 1 and 2, herpes zoster, cysticercosis, human immunodeficiency virus (HIV), and human T-lymphotropic virus were not reactive; no cancerous cells were identified. She also presented a history of seizures and meningitis.

On neurological examination, the patient presented with dysarthria, horizontal nystagmus with preservation of extrinsic eye movement, Grade III strength in upper limbs with wrist spasticity, plegia in lower limbs, and anesthesia from the T12 level without proprioception. She also presented with bicipital, tricipital, and styloradial hyperreflexia in upper limbs, with bilateral exaltation points and positive Hoffmann's sign, besides patellar and aquilean areflexia, and negative Babinski's sign.

For better evaluation, magnetic resonance imaging (MRI) images of the brain and spine were requested. Brain MRI showed thickening and leptomeningeal impregnation by gadolinium compromising both lateral fissures, insula, and frontotemporal operculum, evidencing diffuse pachymeningitis [Figure 1]. The MRI of the spine showed marked diffuse leptomeningeal enhancement along the anterior and posterior pial surfaces of all medullary segments, as well as medullary cone, marked segmental narrowing of the medulla at T10-T11 levels with hypersignal in the weighted sequences at T1 and T2/STIR associated with the tumefactive effect of the cone spinal cord with intramedullary lesion at this level, hypointense in T1-weighted image and hyperintense in T2/STIR weighted [Figure 2].

From the imaging findings and their relationship with the clinic, the patient underwent surgery and biopsy of the lesion. A T10-T11 laminectomy was performed and, after straight opening of the dura mater, a whitish lesion was found in the intramedullary region, suggestive of an abscess, being, therefore, drained and biopsied for analysis [Figure 3].

The culture of the surgical specimen tested positive for *C. albicans* and the histopathological evaluation of the lesion revealed extensive fibrinoid material and presence of hyaline septate pseudohyphae and fungal spores, with strong impregnation by Grocott methenamine silver stain [Figure 4]. These findings are consistent with intramedullary abscess due to *C. albicans* infection, being the second case report in the literature.

DISCUSSION

Candida spp. are considered opportunistic commensal pathogens that promote infection under host predisposing conditions.[55] When the CNS is involved in patients with systemic candidiasis, several clinical manifestations can

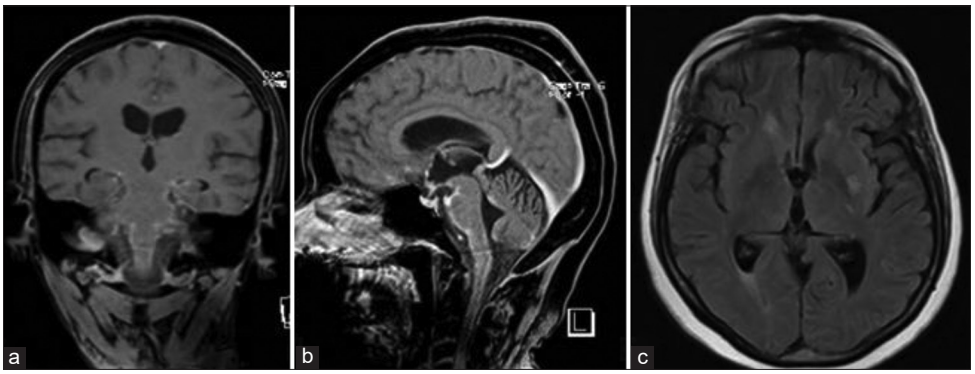

Figure 1: Preoperative magnetic resonance imaging. (a) Coronal gadolinium-enhanced image, (b) sagittal gadolinium-enhanced image, (c) axial T2/FLAIR-weighted image showing a slight reduction in the thickness of the leptomeningeal impregnation of the lateral fissures and frontotemporal operculum on both sides suggestive of diffuse pachymeningitis.

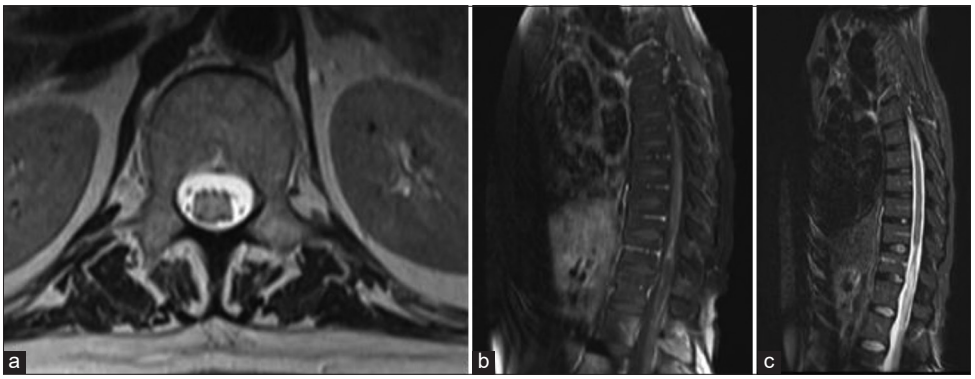

Figure 2: Preoperative magnetic resonance imaging. (a) Axial T2/STIR-weighted image, sagittal T1 and T2/STIR-weighted image, (c) sagittal T2/STIR-weighted showing the intramedullary abscess hypointense on images (a and b) and hyperintense on image (c).

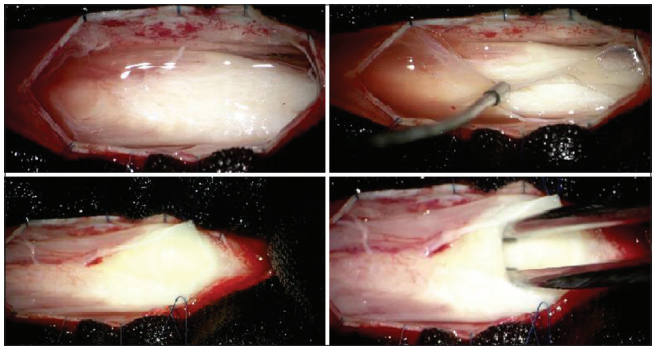

Figure 3: Intramedullary abscess drainage surgery.

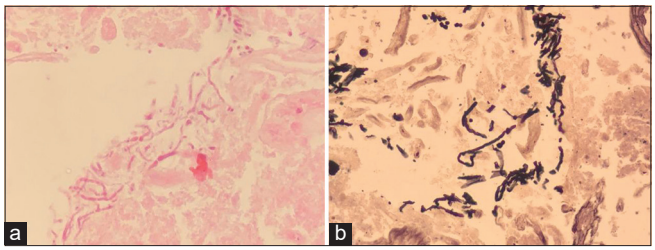

Figure 4: Histopathology revealed numerous septate pseudohyphae and fungal spores embedded in fibrinoid material (a, H and E, ×400). There was intense silver impregnation by Grocott methenamine silver stain, suggestive of *Candida albicans* (b, GMS, ×400).

be overlooked due to the severity of the patient's situation. It is primarily found in immunocompromised hosts[56] or when anatomic barriers are breached by surgery, implanted devices, nonpenetrating blunt trauma to the back, or intermittent systemic corticosteroid,[17] typically leading to decrease in the level of consciousness, meningitis, and cerebral microabscesses.[7] However, other manifestations such as macroabscesses, sometimes suggestive of spinal tumors, are a more rare entity, especially when intramedullary.[56] Nevertheless, infection by *Candida* spp. has also been reported in immunocompetent individuals, as in this case report, but it is a rare event.[35,38,39,53]

There are a wide array of infectious causes of intramedullary myelitis, most of them caused by *B. burgdorferi, Treponema pallidum, Mycobacterium tuberculosis,* HIV, herpes simplex virus, varicella-zoster virus, CMV, Epstein-Barr virus), rabies, and schistosomiasis.[22] When the infection leads to an intramedullary spinal cord abscess, it is usually associated with high mortality and neurological morbidity and rarely encountered in modern neurosurgical practice.[10] We reviewed all cases of spinal intramedullary abscesses in the past 10 years [Table 1].[12-73] We found that approximately 68% of patients were male and 32% of female, the median age was 25, 86 years old (4 months – 82 years old), the main location was at thoracic level and the most frequent pathogen was from a tubercular source. Among all the reports, none of them identified an intramedullary abscess caused by *C. albicans*, which demonstrates the rarity of this entity once again.

C. albicans spinal infection still configures a challenging diagnostic. MRI is useful in diagnosing medullary abscesses, but those infections may mimic a neoplastic process as myxopapillary ependymoma or leptomeningeal carcinomatosis.[7] Besides, the albuminocytologic dissociation often present may come from Guillain–Barré syndrome, cerebral meningitis, malignant lymphoma, spinal hemangioma, multiple sclerosis, central hemorrhagic disease, myelitis, and cerebrospinal infarction, making diagnosis more difficult.[53] However, the CSF of patients with candidal CNS abscesses generally presents no biochemical or cytologic abnormalities. Proteins are usually discreetly high, and a discreet pleocytosis with polymorphonuclear or lymphocytic predominance can be equally frequent,[56] which increases the suspicion of a *Candida* infection, especially when the diagnosis is uncertain, as in the case presented. In addition, some studies still highlight genes related to candidiasis.[23] Colony-stimulating factor 2, Ras protein-specific guanine nucleotide-releasing factor 1, and phospholipase C gamma 2 are examples related to increased susceptibility to CNS *Candida* infection, but functional and bioinformatic studies are needed to identify possible variants that could have influenced *Candida* spp.

Table 1: Studies published in the past 10 years reporting intramedullary abscess.

Paper	Age (years)	Sex	Place	Anamnesis	Pathogens
Higuchi *et al.*, 2011[26]	51	M	T2-T7	Fever and tetraplegia	*S. viridans*
Iwasaki *et al.*, 2011[29]	61	M	T10-Conus	Paraparesis and hypesthesia	Cryptogenic sources
Houx *et al.*, 2011[28]	16 months	M	C2-S1	Tetraplegia	*Prevotella oralis* and *Peptostreptococcus asaccharolyticus*
Roh *et al.*, 2011[51]	78	M	T9	Sudden onset of drowsiness, weakness in both legs and a 4 day history of back pain, fever, chills, and myalgia. Flaccid paraplegia and complete sensory loss, except for light touch, below the level of T4.	*Listeria monocytogenes*
Akhaddar *et al.*, 2011[4]	82	M	T6-T7	Difficulty walking without sphincter disturbance or fever. Moderate left lower extremity weakness with the Babinski sign	*E. coli*
Terterov *et al.*, 2011[67]	59	M	C3-C7	Rapidly progressive quadriparesis	*S. viridans*
Hood *et al.*, 2011[27]	57	M	C6-T1	Severe neck and shoulder pain, which progressed over several days to right-sided hemiparesis with dysesthesias.	*S. aureus*
Malik *et al.*, 2011[41]	5	M	T11-L1	Acute progressed from urinary hesitancy and frequency to complete urinary retention	*Mycobacterium tuberculosis*
Aggarwal *et al.*, 2011[2]	5	F	T12-L1	Acute-onset paraparesis with differential loss of sensation	Sterile on culture
Mohindra *et al.*, 2012[45]	3	F	Holocord	Worsening gait problems, urinary incontinence, complete loss of sensation below D4 level, flaccid paraplegia, with no grip in both hands	*S. aureus*
Hassan *et al.*, 2012[25]	53	M	Conus	Acute retention of urine following an acute onset of back pain and left-sided buttock numbness, decreased sensation in the left side S-3/4 dermatomal area and some lower lumbar spine tenderness and follow by rapid and progressive paraparesis	*Streptococcus milleri* and *S. intermedius*
Silva *et al.*, 2012[59]	52	M	C4-C5	Tetraparesis, predominantly on the left side, and hyperreflexia in lower limbs with preserved vibration and position sensation in all four limbs.	*Staphylococcus epidermidis*
Ferroir *et al.*, 2012[21]	60	M	T12-L3	Paraplegia	*S. aureus*
Kapu *et al.*, 2012[32]	38	F	T12-L1	Insidious onset, slowly progressing back pain with pain radiating anteriorly to abdomen of 1 week duration associated with weakness and numbness of both lower limbs	Neurocysticercosis
Khalid *et al.*, 2012[36]	4	M	T1-T6	Fever and acute flaccid paralysis	*M. tuberculosis*
Kim *et al.*, 2012[37]	63	M	L1	Recurrent meningitis	*S. aureus*
Chopra *et al.*, 2012[16]	18 months	M	T5-T6	Progressive weakness of the lower limbs	Tubercular source
Bukhari *et al.*, 2013[14]	1	m	L3-S3	Fever, stiffness on the neck, and the reflexes over the upper and lower limbs were exaggerated	*S. milleri* and *Bacteroides fragilis*
Sinha *et al.*, 2013[60]	44	F	C2-C5	Gradually progressive weakness on the left side of her body with numbness on the contralateral side	*S. milleri*
Tekin *et al.*, 2013[66]	36	M	T10	Fever and signs of meningeal irritation	Tubercular source
da Silva *et al.*, 2013[18]	1	F	T2-L3	Fever and with progressive and ascending weakness.	Pyogenic infection

(Contd...)

Table 1: (*Continued*).

Paper	Age (years)	Sex	Place	Anamnesis	Pathogens
Sanaullah *et al*., 2013[54]	14	M	T12-L1	Paraparesis of the lower limbs and a progressive loss of power of Grade 3/5, and hypoesthesia in the L4/L5 dermatomes of his right lower limb.	Tubercular source
Bommakanti *et al*., 2013[13]	33	M	Holocord	Intermittent fever associated with chills and rigors for 6 days and sudden onset of weakness in both the lower limbs, complete loss of sensations below the level of nipples and urinary retention, lower limb weakness and bladder incontinence	Tubercular source
Thakar *et al*., 2013[68]	45	F	C5-C6	High-grade fever, neck pain, paresthesias in all limbs, decreased sensation in the trunk, rapidly progressive, decreased sensation in the trunk, rapidly progressive, lower limb weakness, and bladder incontinence	*E. coli*
Ramesh *et al*., 2013[49]	18 months	F	Holocord	Rapidly progressive paraplegia with fever	*E. coli* and *Pseudomonas aeruginosa*
Nicola *et al*., 2014[47]	9 months	M	C4-C6	Right hemiparesis	*P. mirabilis*
Tan *et al*., 2014 [64]	55	M	C2-C3	Rapidly progressed to quadriplegia with worsening mental status	*Coccidioides immitis*
Whitson *et al*., 2014[73]	17	M	C5-T2	Bicep and deltoid weakness with fever of 38.3°C and leukocytosis of 11,500 cells/dl.	*Mycoplasma hominis*
Vadivelu *et al*., 2014[69]	17 months	M	L1-S1	Decreased oral intake, constipation, regression in developmental motor milestones, legs atrophy and lower extremities bear weight.	*Klebsiella oxytoca* and *Pseudomonas*
	26 months	M	L1-S1	Fever, neck stiffness, vomiting, lethargy, and difficulty bearing weight.	*Enterococcus faecalis* and *E. coli*
Kanaheswari *et al*., 2014[31]	2 years and 3 months	M	T9-S2	Fever, cough, lethargy, acute urinary retention. lower limbs hypotonia, areflexia, and loss of sensation.	*Enterobacter sakazakii*
McCaslin *et al*., 2014[43]	19	F	T12-L1	Several fever and bilateral lower extremity weakness.	*Aspergillus*
Takebe *et al*., 2014[63]	65	M	T11-T12	Left thigh pain, urinary incontinence legs weakness and numbness, saddle anesthesia, paraparesis, hypesthesia to thermal and painful nociception, and light touch sensation below the level of the left L-1 and right L-2 segments, including the perianal area.	*S. aureus*
Chittem *et al*., 2014[15]	33	M	Holocord	Fever, rapidly progressive weakness of lower limbs and urinary retention	*M. tuberculosis*
	40	F	Holocord	Paresthesia of lower limbs	*M. tuberculosis*
Arnaiz-Garcia *et al*., 2015[8]	42	M	C5 to T1	Fever, cephala lethargy, vomiting, left side numbness, lack of sphincter control.	*S. aureus*
Kamat *et al*., 2015[30]	2	F	Entire neural axis	Flaccid quadriparesis and septic shock	*P. mirabilis*
Papaevangelou *et al*., 2015[48]	15 months	F	Extending from the mid-thoracic spine up to the brainstem	High fever, right side weakness. severe right hemiparesis (+2/5), ptosis of the right eyelid, salivation, and difficulty breathing and swallowing.	*Corynebacterium* species and *Peptococcus* species

(Contd...)

Table 1: (*Continued*).

Paper	Age (years)	Sex	Place	Anamnesis	Pathogens
Bhanage *et al.*, 2015[12]	4 months	F	T11-S2	Intermittent fever, lethargy, weak cry, refusal of feeds, acute onset weakness of both lower limbs.	*M. tuberculosis*
Dho *et al.*, 2015[20]	12 months	F	Holocord intramedullary abscess	High fever, progressive paraparesis; vomiting, lethargia, hypesthesia below the C4 dermatome, bilateral biceps jerks weakness and bilateral knee and ankle jerks absent.	*Peptoniphilus asaccharolyticus*
Bajema *et al.*, 2016[9]	20	M	Cervical spine	Progressive proximal right upper extremity weakness, urinary retention and occasional incontinence	*Coccidioidomycosis*
Karaaslan *et al.*, 2016[33]	1	M	Extend through the whole spinal cord	Paraplegia, bladder dysfunction, neck rigidity, bilateral lower extremity weakness, and distended bladder with overflow incontinence.	*E. coli*
Vo *et al.*, 2016[72]	35	M	C2-C5	Decreasing sensation and worsening motor strength in all four extremities	*Streptococcus pneumoniae*
Shaikh *et al.*, 2016[58]	10 months	F	Holocord abscess	Fever, bilateral lower limb weakness with urinary retention, flaccid paraplegia	Congenital dermal sinus
Sugawara *et al.*, 2016[62]	60	M	C3-C4	Neck pain and rapidly progressive palsy of the left upper arm	*Fusobacterium nucleatum* and *Peptostreptococcus micros*
Damaskos *et al.*, 2016[19]	77	F	L5-S1	Back pain associated with intense radicular pain irradiating mainly to the right calf and urinary incontinence	*S. aureus*
Kasundra *et al.*, 2016[34]	17	M	Cervical and dorsal cord	Fever, acute sensorimotor paraparesis, absent of tendon reflexes, and anesthesia below D9 spinal level.	Tuberculous longitudinally extensive myeloradiculopathy
Sahoo *et al.*, 2016[52]	22	F	D7-D8	Fever, weakness and numbness of both lower limbs with retention of urine, and bilateral hypoacusis	Tubercular source
Liu *et al.*, 2016[40]	28	M	T11	Lower back pain, lower limb sensory, motor dysfunction, spastic paresis, and exaggerated bilateral tendon reflexes.	Tubercular source
Muniz *et al.*, 2017[46]	21 months	F	T3	Fever with output of purulent material	Congenital dermal sinus
Vankipuram *et al.*, 2017[70]	1	M	C5-D6	Swelling over the left upper dorsal region with intermittent fever, weakness of the lower limbs	No growth on bacterial culture
Tassigny *et al.*, 2017[65]	15 months	F	L1-S3	Progressive bilateral lower limb weakness and flaccid paraplegia	*E. coli*
Marciano *et al.*, 2017[42]	57	M	T5-T11	Progressive back pain, paraparesis, and decreased sensation below the umbilicus	N/A
Ghali *et al.*, 2017[24]	9 months	M	T8-T10	Subacute fever and back tenderness, opisthotonic posture, macrocephaly, a splayed, tense, bulging anterior fontanel, and nuchal rigidity	Tubercular source
Verdier *et al.*, 2018[71]	10	F	C2-C6	Fever, stiff neck, back cervical pain, and progressive left hemiparesis	*S. viridans*
Ratre *et al.*, 2018[50]	14	M	C5-C6	Asymmetric spastic quadriparesis, four limbs hypertonia, deep tendon reflexes were diminished in bilateral upper limbs, and exaggerated in both the lower limbs.	Tubercular source

(Contd...)

Table 1: (*Continued*).

Paper	Age (years)	Sex	Place	Anamnesis	Pathogens
Acharyya *et al*., 2018[1]	11 months	F	L5-S1	Weakness in lower limbs and left upper limb, spastic paraparesis of both lower limbs with exaggerated deep tendon reflexes.	Gram-negative bacilli
Alsubaie *et al*., 2019[6]	10 months	F	T6-T7	Loss of ability to sit and crawl, persistent swelling at mid-back (thoracic area), fever	*Finegoldia magna*
Agyei *et al*., 2019[3]	N/A	M	C2-C3	Upper and lower extremity weakness	*Fusarium* species
Sode *et al*., 2019[61]	23	F	T4-T6	Paraplegia, sensory impairment	Tubercular source
Meegada *et al*., 2020[44]	10	F	T11-T12	Intermittent headaches, fever, neck pain	Tubercular source
Bevan *et al*., 2020[11]	3	F	Cervical	Gait disturbance	No growth on bacterial culture
	1	F	Cervical	Torticollis, lethargy, fever, tachypnea	*Propionibacterium* species
Seroto *et al*., 2020[57]	N/A	N/A	Cervical	History of nonmissile penetrating injury of the spine	N/A
Akimoto *et al*., 2020[5]	17	M	T5-T12	Meningeal signs, paraplegia, sensory impairment, and urinary retention	*S. intermedius*

N/A: Not available, M: Male, F: Female, *S. viridans*: *Streptococcus viridans*, *E. coli*: *Escherichia coli*, *S. aureus*: *Streptococcus aureus*, *M. tuberculosis*: *Mycobacterium tuberculosis*, *S. intermedius*: *Streptococcus intermedius*, *S. milleri*: *Streptococcus milleri*, *P. mirabilis*: *Proteus mirabilis*

infection reported in this article. As we have discussed, there are cases with no laboratory evidence of immunodeficiency or no identifiable cause of immunosuppression,[7] as we observed in this case report.

CONCLUSION

C. albicans intramedullary abscess represents a very rare clinical entity, especially in immunocompetent patients. It must, however, be considered as an important etiology for spinal intramedullary abscesses and as a differential diagnosis in intramedullary pathologies. Critical evaluation of every case, early diagnosis, timely referral and surgical management of the abscess is essential to improve neurological outcome.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Acharyya S, Chakravarty S. Congenital dermal sinus with extensive intramedullary expansion and an infected spinal epidermoid cyst in an infant. J Family Med Prim Care 2018;7:1103-5.
2. Aggarwal M, Aggarwal KC, Karamchand L, Aggarwal A. Intramedullary spinal cord abscess masquerading as spinal tumor. Indian Pediatr 2011;48:973-4.
3. Agyei JO, Qiu J, Fabiano AJ. Fusarium species intramedullary spinal cord fungus ball: Case report. J Neurosurg Spine 2019;31:440-6.
4. Akhaddar A, Boulahroud O, Boucetta M. Chronic spinal cord abscess in an elderly patient. Surg Infect (Larchmt) 2011;12:333-4.
5. Akimoto T, Hirose S, Mizoguchi T, Yokota Y, Hara M, Ishihara M, *et al*. Ruptured long intramedullary spinal cord abscess successfully treated with antibiotic treatment. J Clin Neurosci 2020;82:249-51.
6. Alsubaie S, Dolgum S, Binkhamis K, Alweijri I, Bugshan A, Alzamil F. Finegoldia magna causing intramedullary thoracic spinal cord abscess in an infant. Anaerobe 2019;56:57-60.
7. Argersinger DP, Natkha VP, Shepard MJ, Thomas AA, Oler AJ, Williamson PR, Chittiboina P, Heiss JD. Intradural cauda equina Candida abscess presenting with hydrocephalus: Case report. J Neurosurg Spine 2019;1-4.
8. Arnáiz-García ME, González-Santos JM, López-Rodriguez J, Dalmau-Sorli MJ, Bueno-Codoñer M, Arévalo-Abascal A. Intramedullary cervical abscess in the setting of aortic valve endocarditis. Asian Cardiovasc Thorac Ann 2015;23:64-6.
9. Bajema KL, Dalesandro MF, Fredricks DN, Ramchandani M. Disseminated coccidioidomycosis presenting with intramedullary spinal cord abscesses: Management challenges. Med Mycol Case Rep 2016;15:1-4.
10. Bakhsheshian J, Kim PE, Attenello FJ. Intramedullary cervical spinal cord abscess. World Neurosurg 2017;106:1049.e1-2.
11. Bevan R, Leach P. Infected congenital cervical dermal sinuses

leading to spinal cord abscess: Two case reports and a review of the literature. Childs Nerv Syst 2021;37:225-8.
12. Bhanage A, Katkar A, Ghate P, Ratta B. Intra-medullary tubercular abscess with spinal dysraphism: An unusual case. J Pediatr Neurosci 2015;10:73-5.
13. Bommakanti K, Alugolu R, Chittem LR, Patil M, Purohit AK. Fulminant holocord intramedullary tubercular abscess with enigmatic presentation. Surg Neurol Int 2013;4:32.
14. Bukhari EE, Alotibi FE. Fatal *Streptococcus* melleri meningitis complicating missed infected intramedullary dermoid cyst secondary to dermal sinus in a Saudi child. J Trop Pediatr 2013;59:246-9.
15. Chittem L, Bommanakanti K, Alugolu R. Precipitation sign: A new radiological sign for spinal intramedullary tubercular abscess. Spinal Cord 2014;52 Suppl 1:S1-2.
16. Chopra A, Patra B, Aneja S, Mukherjee S, Maheswari A, Seth A. Spinal congenital dermal sinus presenting as a diagnostic conundrum. Pediatr Neurosurg 2012;48:187-90.
17. Crane JK. Intrathecal spinal abscesses due to *Candida albicans* in an immunocompetent man. BMJ Case Rep 2018;2018:bcr-2017-223326.
18. da Silva PS, de Souza Loduca RD. Intramedullary spinal cord abscess as complication of lumbar puncture: A case-based update. Childs Nerv Syst 2013;29:1061-8.
19. Damaskos D, Jumeau H, Lens FX, Lechien P. Intramedullary abscess by *Staphylococcus aureus* presenting as cauda equina syndrome to the emergency department. Case Rep Emerg Med 2016;2016:9546827.
20. Dho YS, Kim SK, Wang KC, Phi JH. Catastrophic intramedullary abscess caused by a missed congenital dermal sinus. J Korean Neurosurg Soc 2015;57:225-8.
21. Ferroir JP, Lescure FX, Giannesini C, Elghozi D, Marro B. Paraplégie flasque due à des abcès intramédullaires et épiduraux à staphylocoques dorés. Méningite et spondylodiscite associées [Paraplegia associated with intramedullary spinal cord and epidural abcesses, meningitis and spondylodiscitis (*Staphylococcus aureus*)]. Rev Neurol (Paris) 2012;168:868-72.
22. Flanagan EP, Pittock SJ. Diagnosis and management of spinal cord emergencies. Handb Clin Neurol 2017;140:319-35.
23. Gavino C, Hamel N, Zeng JB, Legault C, Guiot MC, Chankowsky J, *et al*. Impaired RASGRF1/ERK-mediated GM-CSF response characterizes CARD9 deficiency in French-Canadians. J Allergy Clin Immunol 2016;137:1178-88.e7.
24. Ghali MG, Srinivasan VM, Kim MJ, Malik A. Spinal intramedullary tuberculosis with concurrent supra-and infratentorial intracranial disease in a 9-month-old boy: Case report and comprehensive review of the literature. World Neurosurg 2017;106:37-45.
25. Hassan MF, Mohamed MB, Kalsi P, Sinar EJ, Bradey N. Intramedullary pyogenic abscess in the conus medullaris. Br J Neurosurg 2012;26:118-9.
26. Higuchi K, Ishihara H, Okuda S, Kanda F. A 51-year-old man with intramedullary spinal cord abscess having a patent foramen ovale. BMJ Case Rep 2011;2011:bcr1120103512.
27. Hood B, Wolfe SQ, Trivedi RA, Rajadhyaksha C, Green B. Intramedullary abscess of the cervical spinal cord in an otherwise healthy man. World Neurosurg 2011;76:361.e15-9.
28. Houx L, Brochard S, Peudenier S, Dam Hieu P, Rémy-Néris O. Recovery after tetraplegia caused by dermal sinus infection: Intramedullary abscess and tetraparesis. Pediatr Neurol 2011;44:229-32.
29. Iwasaki M, Yano S, Aoyama T, Hida K, Iwasaki Y. Acute onset intramedullary spinal cord abscess with spinal artery occlusion: A case report and review. Eur Spine J 2011;20 Suppl 2:S294-301.
30. Kamat AS, Thango NS, Husein MB. Proteus mirabilis abscess involving the entire neural axis. J Clin Neurosci 2016;30:127-9.
31. Kanaheswari Y, Lai C, Raja Lope RJ, Azizi AB, Zulfiqar MA. Intramedullary spinal cord abscess: The result of a missed congenital dermal sinus. J Paediatr Child Health 2015;51:223-5.
32. Kapu R, Singh MK, Pande A, Vasudevan MC, Ramamurthi R. Intradural extramedullary cysticercal abscess of spine. Trop Parasitol 2012;2:131-4.
33. Karaaslan B, Ülkü G, Ucar M, Demirdağ TB, İnan A, Börcek AÖ. Intramedullary dermoid cyst infection mimicking holocord tumor: Should radical resection be mandatory?-A case report. Childs Nerv Syst 2016;32:2249-53.
34. Kasundra GM, Sood I, Bhushan B, Bhargava AN, Shubhkaran K. Distal cord-predominant longitudinally extensive myelitis with diffuse spinal meningitis and dural abscesses due to occult tuberculosis: A rare occurrence. J Pediatr Neurosci 2016;11:77-9.
35. Kawakami N, Mimatsu K, Kato F, Sato K, Matsuyama Y. Intraoperative ultrasonographic evaluation of the spinal cord in cervical myelopathy. Spine (Phila Pa 1976) 1994;19:34-41.
36. Khalid M, Khalid S, Mittal S, Ahmad U. Intramedullary tubercular abscess with syrinx formation. J Pediatr Neurosci 2012;7:61-3.
37. Kim MS, Ju CI, Kim SW, Lee HY. Recurrent bacterial meningitis accompanied by a spinal intramedullary abscess. J Korean Neurosurg Soc 2012;51:380-2.
38. Kumar S, Kaza RC, Tandon A, Nayar M. Subdural spinal fungal granuloma due to *Candida* tropicalis. Case report. J Neurosurg 1979;50:395-6.
39. Lindner A, Becker G, Warmuth-Metz M, Schalke BC, Bogdahn U, Toyka KV. Magnetic resonance image findings of spinal intramedullary abscess caused by *Candida albicans*: Case report. Neurosurgery 1995;36:411-2.
40. Liu J, Zhang H, He B, Wang B, Niu X, Hao D. Intramedullary tuberculoma combined with abscess: Case report and literature review. World Neurosurg 2016;89:726.e1-4.
41. Malik N, Behari S, Ansari MS, Jaiswal AK, Gupta P, Jain M. An intramedullary tuberculous abscess of the conus in a 5-year-old child presenting with urinary dysfunction. World Neurosurg 2011;76:592.e15-8.
42. Marciano R, Ahammad Z, Awuor V. Thoracic spinal cord glioblastoma mimicking epidural abscess: Case report and literature review. Cureus 2017;9:e1631.
43. McCaslin AF, Lall RR, Wong AP, Lall RR, Sugrue PA, Koski TR. Thoracic spinal cord intramedullary aspergillus invasion and abscess. J Clin Neurosci 2015;22:404-6.
44. Meegada S, Gyamfi R, Muppidi V, Dandu V, Challa T. Multiple intracranial tuberculomas with an intra-medullary spinal cord tuberculoma in a pediatric patient. Cureus 2020;12:e7248.
45. Mohindra S, Sodhi HS, Aggarwal A. Management problems of intramedullary holocord abscess: An illustration in a pediatric case. Childs Nerv Syst 2012;28:637-40.
46. Muniz BC, Ribeiro BN, Mufarrej G, Wilner NV, Gasparetto EL.

Cervical spinal dermal sinus associated with intramedullary spinal cord abscess. Arq Neuropsiquiatr 2017;75:133.
47. Nicola Z, Antonio C, De Tommasi A. Cervical dermal sinus complicated with intramedullary abscess in a child: Case report and review of literature. Eur Spine J 2014;23 Suppl 2:192-6.
48. Papaevangelou G, Tsitsopoulos PP, Flaris N, Iliadis C, Tsonidis C. Dermal sinus tract of the thoracic spine presenting with intramedullary abscess and cranial nerve deficits. Pediatr Neurosurg 2015;50:339-43.
49. Ramesh VG, Karthikeyan KV, Kitchanan S, Sriraman B. Holocord abscess in association with congenital dermal sinus. J Pediatr Neurosci 2013;8:198-200.
50. Ratre S, Choudhary S, Yadav Y, Parihar V, Bajaj J, Pateriya A. Concurrent intramedullary and intracranial tuberculomass. J Assoc Physicians India 2018;66:72-4.
51. Roh JE, Lee SY, Cha SH, Cho BS, Jeon MH, Kang MH. Sequential magnetic resonance imaging finding of intramedullary spinal cord abscess including diffusion weighted image: A case report. Korean J Radiol 2011;12:241-6.
52. Sahoo L, Mallick AK, Mohanty G, Swain KP, Nayak S, Sahu AK. Concurrent intramedullary spinal cord and multiple intracranial tuberculomas with tuberculous optic neuritis: A rare case report. Indian J Tuberc 2017;64:337-40.
53. Sakayama K, Kidani T, Matsuda Y, Fujibuchi T, Miyazaki T, Takada K, *et al*. Subdural spinal granuloma resulting from *Candida albicans* without immunosufficiency: Case report. Spine (Phila Pa 1976) 2002;27:E356-60.
54. Sanaullah M, Mumtaz S, Memon AA, Hashim AS, Bashir S. Intramedullary dermoid cyst with relatively atypical symptoms: A case report and review of the literature. J Med Case Rep 2013;7:104.
55. Sanches MD, Mimura LA, Oliveira LR, Ishikawa LL, Garces HG, Bagagli E, *et al*. Differential behavior of non-albicans *Candida* species in the central nervous system of immunocompetent and immunosuppressed mice. Front Microbiol 2019;9:2968.
56. Sánchez-Portocarrero J, Pérez-Cecilia E, Corral O, Romero-Vivas J, Picazo JJ. The central nervous system and infection by *Candida* species. Diagn Microbiol Infect Dis 2000;37:169-79.
57. Seroto PM, Harrington BM, Lombard C, Vlok AJ. The role of tertiary neurosurgical intervention in non-missile penetrating injuries of the spine. Eur Spine J 2020. Doi: 10.1007/s00586-020-06665-4.
58. Shaikh S, Joshi R. Pyomyelia presenting as acute flaccid paralysis. Oxf Med Case Reports 2016;2016:omw052.
59. Silva RT, Souza HC, de Amoreira Gepp R, Batista GR, Horan TA, Oliveira PC. Penetrating cervical spine injury and spinal cord intramedullary abscess. Arq Neuropsiquiatr 2012;70:308-9.
60. Sinha P, Parekh T, Pal D. Intramedullary abscess of the upper cervical spinal cord. Unusual presentation and dilemmas of management: Case report. Clin Neurol Neurosurg 2013;115:1845-50.
61. Sode HC, Ibrahim A, Beranger HS, Soong-Meenga NH, Aminath K, Samuila S. Abcès pottique intra médullaire: À propos d'un cas [Intramedullary Pott's abscess: A case study]. Pan Afr Med J 2019;34:186.
62. Sugawara A, Ishigaki D, Isu T, Ogasawara K. Intramedullary abscess of the cervical spinal cord caused by advanced periodontitis: Case report. No Shinkei Geka 2016;44:685-9.
63. Takebe N, Iwasaki K, Hashikata H, Toda H. Intramedullary spinal cord abscess and subsequent granuloma formation: A rare complication of vertebral osteomyelitis detected by diffusion-weighted magnetic resonance imaging. Neurosurg Focus 2014;37:E12.
64. Tan LA, Kasliwal MK, Nag S, O'Toole JE, Traynelis VC. Rapidly progressive quadriparesis heralding disseminated coccidioidomycosis in an immunocompetent patient. J Clin Neurosci 2014;21:1049-51.
65. Tassigny D, Fomekong E, Koerts G, Raftopoulos C. Intramedullary holocord abscess secondary to infected dermoid cyst. Acta Neurochir (Wien) 2018;160:209-12.
66. Tekin R, Kaçar E, Çevik FC, Çinar K, Çevik R. Intracranial and intramedullary tuberculoma with intravertebral abscess manifestation under anti-tuberculous treatment: A case report. Clin Neurol Neurosurg 2013;115:1858-60.
67. Terterov S, Taghva A, Khalessi AA, Kim PE, Liu C. Intramedullary abscess of the spinal cord in the setting of patent foramen ovale. World Neurosurg 2011;76:361.e11-4.
68. Thakar S, Rao A, Mohan D, Hegde A. Metachronous occurrence of an intramedullary abscess following radical excision of a cervical intramedullary pilocytic astrocytoma. Neurol India 2013;61:322-4.
69. Vadivelu S, Desai SK, Illner A, Luerssen TG, Jea A. Infected lumbar dermoid cyst mimicking intramedullary spinal cord tumor: Observations and outcomes. J Pediatr Neurosci 2014;9:21-6.
70. Vankipuram S, Sahoo SK, Srivastava C, Ojha BK. Spinal cord abscess secondary to infected dorsal dermal sinus in an infant: Uncommon presentation of a known entity. BMJ Case Rep 2017;2017:bcr2017222366.
71. Verdier EP, Konsol O, Portillo S. Intramedullary cervical abscess mimicking a spinal cord tumor in a 10-year-old girl: A case-based review. Childs Nerv Syst 2018;34:2143-7.
72. Vo DT, Cravens GF, Germann RE. *Streptococcus pneumoniae* meningitis complicated by an intramedullary abscess: A case report and review of the literature. J Med Case Rep 2016;10:290.
73. Whitson WJ, Ball PA, Lollis SS, Balkman JD, Bauer DF. Postoperative *Mycoplasma hominis* infections after neurosurgical intervention. J Neurosurg Pediatr 2014;14:212-8.

How to cite this article: Raffa PE, Vencio RC, Ponce AC, Malamud BP, Vencio IC, Pacheco CC, *et al*. Spinal intramedullary abscess due to *Candida albicans* in an immunocompetent patient: A rare case report. Surg Neurol Int 2021;12:275.