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Review Article

Diagnosis, and Treatment of Cervical Epidural Abscess and/or Cervical Vertebral Osteomyelitis with or without Retropharyngeal Abscess; A Review

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ABSTRACT

Background: Every year approximately 19.6 patients/100,000 per year are admitted to hospitals with spinal epidural abscesses (CSEA), 7.4/100,000 have vertebral osteomyelitis (VO)/100,000/year, while 4.1/100.000 children/year have cervical retropharyngeal abscesses (RPA) (i.e., data insufficient for adults).

Methods: Here we evaluated 11 individual case studies, 6 multiple patient series, and looked at 9 general review articles focusing on CSEA, and/or VO, with/without RPA.

Results: Of the 11 case studies involving 15 patients, 14 had cervical spinal epidural abscesses (CSEA: 10 CSEA/VO/RPA, 2 CSEA/VO, 1 CSEA/TSEA, 1 CSEA/ TSEA/LSEA), 13 had cervical osteomyelitis (VO: 11 VO/CSEA, 2 VO/RPA), and 12 had cervical retropharyngeal abscesses (RPA: 10 RPA/CSEA/VO, 2 RPA/VO alone). When patients were treated surgically, they required 12 anterior, and 2 posterior approaches; 1 patient required no surgery. In the 6 larger cervical series involving 355 patients, 4 series involved CSEA (3 CSEA, 1 CSEA/VO), and 2 seires had cervical VO. Primary surgery was performed in 298 patients, while 57 were initially managed medically; 24 of these latter patients failed non-surgical therapy, and required delayed cervical surgery. Notably, all 17 clinical studies advocated early surgery where clinically appropriate for varying combinations of CSEA and/or VO with or without RPA. The 8 final articles reviewed all-levels of SEA and or VO, while also providing additional unique information regarding RPA.

Conclusion: We analyzed 11 case studies and 6 multiple case series regarding the diagnosis and treatment of combinations of cervical CSEA, and/or VO with or without RPA. We also reviewed 8 articles on the evaluation/management of all-level SEAs and/or VOs, along with the unique features of RPAs.

Keywords: Cervical spine epidural abscesses, How to recognize failure of medical management, Retropharyngeal abscesses, Success of early surgery where appropriate for CSEA and/or VO with/without RPA, Vertebral osteomyelitis

INTRODUCTION

Every year approximately 19.6 patients/100,000 are admitted to hospitals with spinal epidural abscesses (CSEA), 7.4/100,000 have vertebral osteomyelitis (VO) /100,000, and 4.1/100,000 children have cervical retropharyngeal abscesses (RPA) (i.e. data insufficient for adults).[1,2,9,10,13,16,18,20,22] Our focus was on how to best recognize, diagnose, treat (surgically vs. non-surgically), and analyze outcomes for varying combinations of cervical CSEA, and/or VO with/

without RPA in 11 case studies and 6 multiple-patient series. We also reviewed 8 articles addressing all-level SEA, VO, and some additional background on RPAs.[1-25] Most articles emphasized the need for the early diagnosis of CSEA, VO, and RPAs, and to recognize when surgery is primarily or secondarily indicated (i.e. when medical management has failed).[1,2,9,10,16,18,20,22]

11 CASE STUDIES INVOLVING 15 PATIENTS WITH CERVICAL EPIDURAL ABSCESSES (CSEA) AND/OR CERVICAL VERTEBRAL OSTEOMYELITIS (VO) WITH OR WITHOUT CERVICAL RETROPHARYNGEAL ABSCESS (RPA)

In 11 case studies, there were 15 patients who presented with varying frequencies of cervical epidural abscesses (CSEA: 14 patients), and/or vertebral osteomyelitis (VO: 13 patients) with or without retropharyngeal abscesses (RPA 11 patients) [Table 1].[3-6,8,11,13,15,19,24,25] Patients averaged 49.1 years of age in 6 studies (Range 18–69).[4,11,13,15,19,24] Note that in all but 2 studies, patients had multiple overlapping pathologies. In the 14 patients with CSEA, 10 had accompanying VO/RPA, 2 had VO, while 2 had SEA alone (i.e. 1 CSEA/TSEA, and 1 holocord abscess CSEA/TSEA/LSEA).[3-6,8,11,13,19,24,25] For the 13 patients with VO, 10 additionally had CSEA/RPA, 2 had CSEA and 1 had an RPA.[3-6,8,11,13,15,24] Of the 11 patients with RPA, 10 had accompanying CSEA/VO, while one had additional VO alone.[4,5,8,11,13,15,24]

Sources and Organisms Associated with CSEA and/or Cervical VO with/without RPA

Distinct sources of infection/organisms for cervical CSEA and/or cervical VO, with/without RPA included: 2 dental extractions (*Pseudomonas aeruginosa*),[24] 1 ablation of pharyngeal cancer (*Staphylococcus aureus*),[6] 1 meningitis (*E. coli*),[11] 1 cranio-cervical trauma (*Staphylococcus aureus*),[8] 1 cervical epidural steroid spinal injection (ESI: Staph A),[25], 1 immunocompromised patient with cirrhosis (*E. coli*),[15] and 1 urinary tract infection (*E. coli*);[13] the remainder of cases were attributed to the hematogenous spread of *Staphylococcus aureus* [Table 1].[3-5,19]

Surgical Options for CSEA, and/or Cervical VO with/without RPA

Surgical intervention, warranted in 14 ouf of 15 cases, included 12 anterior procedures (i.e. typically multilevel anterior corpectomy with instrumented fusions), and 2 posterior procedures (i.e. including multilevel laminectomies).[3-6,8,11,13,15,19,24] Where the patient had undergone a cervical epidural steroid injection (ESI) resulting in a C6-T8 CSEA/TSEA, antibiotics alone effectively resolved the infection.[25]

6 LARGER SERIES INVOLVING 355 PATIENTS WITH CERVICAL EPIDURAL ABSCESS (CSEA) AND/OR CERVICAL VERTEBRAL OSTEOMYELITIS (VO) WITH OR WITHOUT CERVICAL RETROPHARYNGEAL ABSCESS (RPA)

There were 6 larger cervical series involving 355 patients included in this analysis; 4 series specifically addressed CSEA (i.e. 1 also including VO), and 2 series involved cervical VO alone [Table 2].[2,7,14,17,21,23] Surgery was primarily performed in 298 patients, while 57 underwent initial medical management. Of the latter 57 patients, 24 from two series failed medical therapy, and required delayed cervical surgery; medical therapy failed in 6 of 23 (26%) patients in one series, and 18 of 33 (54.5%) patients in the other study.[14,23] Data from 3 of the overall 6 series showed that these patients averaged 56.1 years of age, some with a mild male preponderance.[7,12,17] Common conclusions from these 6 series focusing on CSEA, and/or VO with/without RPA included; (1) early diagnosis with MR examinations is critical to maximize the quality of outcomes, (2) early recognition of failed medical management and/or the need for primary surgery (where appropriate) is critical, (3) primary application of spinal instrumentation in the presence of infection was safe/effective, (4) and that anterior, posterior, or circumferential surgical procedures had to adequately address the specific pathology as documented in each case [Table 2].[2,7,14,17,21,23]

2 Series Focusing on Cervical Vertebral Osteomyelitis Alone (VO)

Two series focused on the non-surgical and/or surgical management of cervical vertebral osteomyelitis [Table 2].[7,14] One study (1999) pointed out that for 56 patients with VO, there was an average 10.6 week delay before correctly establishing the diagnosis; they emphasized that this was unacceptable, and how it led to major increased permanent morbidity and/or mortality for patients with VO.[14] Primary surgery was chosen for 33 of the 56 patients who met the following criteria; a significant presenting motor deficit, substantial MR-documented epidural spinal cord compression, and/or the presence of kyphosis. The other 23 patients without initial neurological deficits and/or kyphosis underwent primary non-surgical management; 6 failed medical therapy, and required delayed surgery. The total surgical procedures for the 39 patients in this series included; 17

Table 1: 11 Case Studies of Cervical Spinal Epidural Spinal Abscess (CSEA) and/or Vertebral Osteomyelitis (VO), with or without Retropharyngeal Abscess (RPA).

Author Ref Journal	Case Studies	Background	Background	Background	Conclusions
Faidas[4] Clin Infect Dis 1994	Case Cervical CSEA RPA VO 66 yo M RPA CSEA and VO	Presenting as RPA	Cervical VO	Caused by Staph A	Cervical CSEA 66 yo M with RPA and VO Due to Staph A
Walters[24] Spine 2008	**2 Cases Cervical CSEA VO RPA** Due to Dental Extraction	18 yo male 23 yo F Neck Pain Within 24 Hours	MR showed CSEA and VO Delay in Diagnosis	Surgical Drainage Anterior ACF IV Long Antibiotics	Organism Pseudomonas Aeruginosa 3 months : Intact
Chang[3] Surg Neurol 2008	**Case Cervical CSEA and VO**- Multilevel VO- Long Segment	1 Stage Anterior ACF with Mesh Cage Titanium Plate	Hyperbaric Oxygen 6 weeks IV Antibiotics	Able to Use Instruments Primarily with CSEA and VO	3 Months Infection Resolved Postop Neuro Intact
Fujioka[6] Surg Neurol 2009	**Case Cervical CSEA VO** Prior Rx Pharyngeal Squamous Cell CA/ Ablation	ACF Fusion - Resected Cervical Wound Tissues	One Stage Pectoralis Major Muscle Flap-Fill Dead Space	Flap Separated VO/CSEA from Retropharyn-geal Space	Pectoralis Flap Filled Void Multilevel ACF
Faruqui[5] Ear Nose Throat J 2009	**4 Cases Cervical CSEA VO RPA** Non Traumatic Cervical RPA Rare Due to CSEA/VO	Contrast MR Diagnosed CSEA, VO, Without IC	Surgical Drainage and Antibiotics	Followed CRP/ ESR Assess Adequacy Treatment	4 Cases RPA and VO with CSEA Treated with Surgical Drainage and Antibiotics
Kohlmann[11] BMC Infect Dis 2015	**Case Cervical RPA VO CSEA** 53 yo F E Coli Meningitis Unrecognized No Rx Weeks Misinterpreted Disc	E Coli Rare in Adults without IC Bacterial meningitis E Coli	Neck Pain Weeks Mistaken Diagnosis Disc Disease*	MR large RPA with VO, CSEA	Meningitis and VO and RPA and CSEA Resolved with Surgery and Meropenem Antibiotic
Goulart[8] JNS Spine 2016	**Case Cervical RPA CSEA VO** VO Due to Traumatic Injury Bone Ligaments	Cranio-Cervical Trauma:	Mucosal Lacerations Oropharynx Secondary Infections No IC	MR Large RPAVO and CSEA Direct Trauma Oropharynx	Unrecognized Trauma Complication of Craniocervical Trauma
Zhang[25] Medicine Baltimore 2017	**Case Cervical CSEA TSEA** Due to ESI **No VO** C6-T8 Severe Neck Pain >WBC	Rapid Worsening Neuro Deficit MR Large C6-T8 CSEA TSEA	Rx IV Vanco Imipenem Cilastatin > 4 weeks No Surgery	At 2 weeks Rx Decreased Size of CSEA/TSEA	WBC and CRP Decreased Neck pain resolved 4 week MR CSEA gone
Sakaguchi[15] 2017 Infez Med	**Case Cervical RPA and VO** 67 yo M Note IC:	Cirrhosis Fever Neck Pain Hemato-genous Spread	MR cervical VO Enhanced CT Showed RPA/VO/CSD	Initial Antibiotics Later Drainage Due to AO E Coli Blood Cultures	Inferior Cervical Levels Surgery Early Diagnosis of RPA to Avoid Complications Like Airway Obstruction
Thomson[19] BMJ Case Rep 2018	**Case Cervical CSEA TSEA and LSEA No VO** 66 yo F Holo-Cord SEA 4 days Fever Lethargy, LBP	Neuro: Mild Quadriparesis Predict Poor outcomes: Older Age More Neuro Compression	Predict Poor outcomes: Longer Duration of Symptoms Prior to Surgery	Spinal Enhanced MR: C-TH-L SEA with CC	Rx: Multiple Laminectomies Prolonged IV Flucloxacillin Cultured Staph A (3 Blood Cultures)

(*Contd...*)

Table 1: (*Continued*)

Author Ref Journal	Case Studies	Background	Background	Background	Conclusions
Moustafa[13] Case Rep Infect Dis 2019	**Case Cervical CSEA VO RPA** 69-yo M Few: E Coli UTI with IC-Urine/ Blood Culture Positive History Prostatitis	SEA 0.33-1.96/10,000 Hospital Admissions/ year 2/3 Staph A	Fever, Neck Pain, Altered Mental Status > LE Weak Falls Over 7 Days, >WBC Level/+ Blood Cultures	LP CSF: 24 WBC Protein 1140 mg/dl No Bacteria MR CSEA C5-C7 Anterior	Prevertebral Abscess C4-T2 with PA/VO C6, C7, VO C67 High Signal on MR-Disc Space Anterior ACF Cultures E Coli More Timely Diagnosis Surgery
Summary Data of 15 Cases	Average age 49.1 Range 18-69	Separate Pathology 14 CSEA 2 No CSEA 11 RPA 13 VO	10 CSEA RPA VO 2 CSEA VO 1CSEA/TSEA	1CSEA/ TSEA/LSEA 1 RPA VO	Surgery Anterior 12 (ACF) Posterior 2 (Lam) No Surgery 1

RPFA=Retropharyngeal Abscess, CD=Cervical diskitis, VO=Vertebral Osteomyelitis, A=Epidural Abscess, LE=Lower Extremity, SD=Spondylodiskitis NSQIP=Am College of Surgeons National Quality Improvement Program Database, ESI=Epidural Steroid Injections, SA=Staph Aureus, PA=Pseudomonas Aeruginosa, ACF=Anterior Corpectomy and Fusion, CA=Cancer, IC=Immunocompromise, CRP=C Reactive Protein, ESR=Erythrocyte Sedimentation Rate, CSD=Cervical Spondylodiskitis, Neuro=Neurological, C-TH-L=Cervical, Thoracic and Lumbar, CC=Cord Compression, M=Male, F=Female, MS=Mental Status, LE=Lowe Extremity Weak=Weakness, AO=Airway Obstruction, Lam=Laminectomy, Th=Thoracic, C=Cervical, L=Lumbar, Sig=Significant, EC=Epidural Compression, Rx=Treatment, mos=Months, AP=Anterior/Posterior Surgery (Circumferential),WBC=White Blood Cell Count, Avg=Average, Rg=Range, Staph A=Staphylococcus Aureus, Strep=Streptococcus, OR=Surgery, COM=Comorbidities, TL=Thoracolumbar, LAM=Laminectomy, LAM/F=Laminectomy with Fusion, LBP=Low Back Pain

anterior, 13 posterior, and 9 circumferential operations.[14] In another study by Ghobrial *et al*. (2017) involving 59 patients with cervical VO, patients averaged 59 years of age, and underwent initial anterior C4-C5, C5-C6, and/or C6-C7 surgical procedures (descending order).[7] Interestingly, better postoperative results were observed for those undergoing anterior surgery alone vs. circumferential procedures. Further, a preoperative intramedullary hyperintense T2 weighted MR cord signal correlated with the severity of the patients' preoperative deficits, but did not correlate or predict their postoperative outcomes. Notably, authors from both studies strongly advocated for earlier recognition of when medical therapy failed, and when surgery was warranted. They further emphasized that primary surgery was indicated in the presence of significant preoperative neurological deficits to avoid permanent postoperative sequelae and/or death.

4 Series of Cervical Spine Epidural Abscess (CSEA)

From 2017-2020, there were 4 series focusing on CSEA, one of which included VO [Table 2].[12,17,21,23] In Li *et al*. (2017), within 24 hours of admission, 14 patients (average age 57.4) with CSEA underwent anterior cervical corpectomy/fusion (ACF) utilizing titanium cages/autograft.[12] Postoperative follow-up utilized successive X-rays, CT, and MR studies to confirm the resolution of CSEA infections, regression of spinal cord compression, and identify progressive fusion without increased instability/deformity. These patients were also closely and repeatedly followed with inflammatory markers (white blood cell count (WBC), Erythrocyte Sedimentation Rate (ESR), C-Reactive Protein (CRP), and blood cultures) to further confirm the failure or efficacy of antibiotic/surgical treatment in resolving infections. They also noted that placing instrumentation during the index procedure was both safe and effective as there were no recurrent infections, and no reoperations for residual/recurrent infections and/or instability/deformity. In 2017, Shweikeh *et al*. looked at 16 CSEA (average age 57.9) involving the C5-C7 levels; 8 had initial surgery (7 anterior, 1 posterior), while 8 were treated medically.[17] Outcomes included; 8 full recoveries, 2 with minimal improvement, 2 deaths, and 4 patients referred to nursing homes or lost to follow-up. For the 173 patients in Turner *et al*. (2019) evaluation of 11 studies (culled out of 927 articles) involving CSEA, 140 patients had primary surgery, while 33 were initially medically managed.[23] Notably, 18 (54.5%) of the latter failed medical therapy; the uniquely high failure rate prompted the authors to conclude that CSEA resulted in a higher rate of failed medical management vs. thoracic (TSEA) and/or lumbar (LSEA) epidural abscesses. For Tonetti *et al*. (2020) series involving 36 CSEA, 44% of whom also had VO, all patients underwent initial surgical decompression with fusion (e.g.

Table 2: 6 Series of Cervical Spinal Epidural Spinal Abscess (CSE) and/or Vertebral Osteomyelitis (VO).

Author Ref Journal	Case Series	Background	Background	Background	Conclusions
Rezai[14] Neurosurgery 1999	**56 Cervical VO** patients 1995-1987 Pain Weakness Avg Duration Symptom Prior To Diagnosis 10.6 wk	33 Initial Surgery: >>Motor Deficit/EC Kyphosis/ Deformity Failed Medical Therapy	No or Minimal Surgery or Preop Neuro Deficits No Kyphosis **23 Initial Medical Rx 6 Failed Need Surgery**	Surgery 39 17 Anterior 13 Posterior 9 AP Used Instrumented Fusion	Follow 24 mos 93% Better/ Intact with Surgery Plus Solid Fusion Recommend: Early Surgery-Rapid Neuro Improvement
Ghobrial[7] World Neurosurg 2017	**59 Cervical VO**- Including Spondylo-diskitis (SCD) Average Age 59 (Rg 18-83)	Significant Risk Rapid Deterioration with Medical Management	Significant Improvement with Surgery C45, C56, C67 Descending Order	T2 MR Preop High Signal=Worse Preop Neuro Status- Not Predict Worse Results	Longer Preop Duration=Poorer Motor Outcome Anterior Surgery Better Results vs. AP Surgery
Li[12] Medicine (Baltimore) 2017	**14 Cervical CSEA** 1 Stage ACF Emergent Titanium Cages/ Autograft	2005-2014 Average age 57.4 yrs; 9M 5F; Followed Avg 27.4 mos Rg 18-36 mos	**Early Surgery: Within 24 hrs of Admission** Postop IV Antibiotics 10-12 weeks	XR, CT, MR Followed Stability Infection Plus WBC, ESR, CRP	No Postop Infections No Instability Neuro Scores Better- JOA, VAS WBC ESR CRP
Shweikeh[17] Spinal Cord Ser Cases 2017	**16 CSEA** 2001-2012 Average age 57.9 (Rg 33-83) 9 F, 7 M 8 Surgery Rx 8 Medical Rx	Pain 62.5% Neuro Deficits 62.5% Fever 31.3% ASCVD 56.3% Renal 37.5% DM 37.5%	> COM/Poorer Outcomes More Lower C5-C7 Levels Organisms Staph A. Strep 68.8%	87.5% Anterior Surgery Surgery 12.5% Posterior Surgery	Recovery 8 Full 2 Minimal 2 Died 4 Skilled Nursing or Lost to Follow- up
Turner[23] Ther Adv Infect Dis 2019	**173 Cervical CSEA** Medical vs. Surgical Rx 11/927 Studies Used	Mean Age 55 61.3% Male Risk Factors Most IV Drugs Most Staph A	140 Initial Surgery Rx 33 Medical Rx 15 Success with Antibiotics Alone	**18 (54.5%) Failed- Medical Rx Late Surgery** >CSEA Fail Medical Rx vs. Th/ LSEA	CSEA >> Risk + Poorer Outcome Medical Rx 129 Local Abscesses: 48 OR: Anterior, Posterior, AP
Tonetti[21] World Neurosurg 2020	**36 Cervical CSEA 44% VO (16)** - 2009-2018	36 Primary Surgical Decompression Fusion Follow 10 yr	Surgery 7 (19%) Anterior 27 (75%) Posterior 2 (6%) AP	**4 (11%) Reoperations** All with VO	VO with CSEA Another Indicator For Early Surgery
Summary	6 Series 2 VO Only 4 CSEA	Total Cases; Total: 355 Average Age Series 56.1 Mild More M vs. F	24 Failed Medical Management 2 Series 6/23 (26%) 18/33 (54.5%)	**Total 298 Primary Surgery Rx 56 Primary Medical Rx**	Predominance Anterior Surgery **24/56 Failed Medical Management**

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7 anterior, 27 posterior, and 2 circumferential procedures). [21] Over a 10 year period, they observed an 11% (4 patients) reoperation rate; interestingly, all occurred in patients with CSEA accompanied by VO.

Table 3: General Review of Cervical Epidural Abscess and/or Vertebral Osteomyelitis and/or Retropharyngeal Abscess (RPA).

Author Ref Journal	Review	Background	Background	Background	Conclusions
Carragee[1] JBJS Am 1997	**111 VO (All Levels) Review** Primary Average age 60 (Rg 18-84) 55% Over Age 60	44 (40%) IC DM, Steroid CA/Chemo IC Diseases Renal/Liver Failure Malnutrition Myelo-dysplasia	103 (93%) MR Early Diagnosis 68 (61%) Diagnosed VO- at 1 month 36% StaphA 13 UTI	4 Factors For Medical Rx Success; Age < 60, No IC Staph A, << ESR 42 Surgery 24/42 Fused; No Infection Recurred	**18 Died Avg 4 years:** 3 Postop 7 Medical Rx 1st Month 3 Later Due to Paraplegia 5 Unrelated
Harkani[9] Scientific WorldJournal 2011	**Cervical 5 RPA/VO (2) Review** All Adults Fever Dysphagia Torticollis Trismus	Local Trauma 4/5 Oral Exam Bulging Posterior Wall Oropharynx	XR CT Mass-Prevertebral Enhancement 2 Cases VO 1 Osteolysis 1 CSD	4 Endobuccal Abscess Puncture Cultured: 1 Surgical Drainage (Diabetic) 4 Staph Aureus 1 TB positive	All Good Outcomes Need Early Diagnosis Avoid Risks Delayed Surgery
Hoang[10] AJR Am J Roentgenol 2011	**Cervical RPA Review** Multiplanar CT and MR Show Retropharyngeal Collection	Differential Diagnoses; Infectious vs. Non Infectious	Multiplanar CT and MR Both show RPA Collections	Reviewed Anatomy of Retropharyngeal Compartment	4 Step Method for Evaluating RPA on Imaging
Toru[22] BMJ Open 2013	**7118 VO (All Levels) Review** Average age 69.2	7118 Patients Diagnosed with MR 2007-2010 58.9% Males	2007 Per Year 5.3/100,000 per 2010 Per Year 7.4/100,000 per	6% Hospital Mortality Risk Factors Trend Older Age Hemodialysis, DM	Risk Factors Cirrhosis Cancer Infectious Endocarditis
Tomita[20] Eur J Radiol 2016	**Cervical RPA Review** of Retropharyngeal Fluid	Retropharyn-geal Collection RPA, VO, Calcific Tendinitis Longus Colli Muscles	Managed by ER MD Orthopedics Pediatrics ENT Oncology	Diagnose RPA with CT/ MR Fluid in Retropharyngeal space	Some Require Emergency Surgery to Avoid Mediastinitis or AO (Airway Obstruction)
Shah[16] JBJS Am 2018	**367 SEA (All Levels) Review** Non-Surgical Management of SEA-Failure Algorithm	Diagnosis SEA 1993-2016	99/367 (27%) Failed Non-Surgical Rx	**6 Predictive Factors forMedical Rx Failure** Motor Deficit, DM, Cord Compression Fracture, Cancer	**6 Predictive Factors of Failure** Sensory Deficit Dorsal Abscess
Chaker[2] Spine 2018	**738 SEA (All Levels) Review** Database 608 LAM vs. 130 Lam/F Study 30 Day Outcomes	Symptoms Neck/ Back Pain Fever Neurological Deficits	**Fusion Group** Worse Health More Return to OR More Cervical CSEA	**Fusion Group** >> Transfusions >> Reoperations Infection most Common Reason for Reoperation	**Fusion 2X Reoperation Rate** Reason to Fuse Short Term vs. Benefits Stability
Stricsek[18] Global Spine J 2018	**Review 11 CSEA Studies** Surgical Rx vs. Non Surgical Rx	11 Articles Accepted Out of PubMed (521) and OVID (974) Databases Surgery Well Tolerated-Few Complications	"Bulk of the data is derived from low quality studies" "Difficult to draw discrete conclusions"	**"Early surgical intervention may be appropriate in selected patients with cervical epidural abscess"**	"Difficult to tell who will be best managed Surgery vs. Medically"

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REVIEW OF ARTICLES CONCERNING ALL-LEVEL SEA, VO, AND ADDED REVIEW OF RPA

A review of an additional 8 articles provided a general overview of the diagnosis and treatment of all-level spinal epidural abscesses (SEA), vertebral osteomyelitis (VO), and also discussed more background information regarding RPA [Tables 1-3].[1,2,9,10,16,18,20,22]

Frequency and Definition of Cervical Spine Vertebral Osteomyelitis

Vertebral osteomyelitis is seen in hospitals at the rate of approximately 7.4 cases/100,000 patients/per year [Tables 2 and 3].[22] Carragee *et al*. (1997) and Toru *et al*. (2013) respectively evaluated 111 and 7118 patients with vertebral osteomyelitis (VO) involving all spinal levels.[1,22] Patients respectively averaged 60 and 69.2 years of age, and exhibited the following significant comorbidities; older age, diabetes, steroid use, cancer, chemotherapy, renal/liver disease, renal failure requiring dialysis, endocarditis, malnutrition, myelodysplasia, and others [Tables 2 and 3]. Those with spinal VO often presented with pain, fever, elevated clinical markers (i.e. WBC, ESR, CRP, positive blood cultures), and motor/sensory neurological deficits (i.e. VO deformity with resultant cord compression, and/or accompanying SEA).[1,14,22] Enhanced MR scans best documented VO (i.e. positive in over 90% of cases), and were typically positive for VO in as few as 2–4 weeks.[1] Further, whenever initial MRs studies were "negative", but patients remained symptomatic, repeated MRs often subsequently readily document VO. Authors generally advocated early diagnosis and early surgery to achieve the best clinical outcomes, and largely supported utilizing instrumentation at the index procedure to avoid deformity/reoperations.[1,2,7,14,17,22] The in-hospital mortality rate in 2013 for all-level VOs was 6%.[22]

Frequency and Definition of Spinal Epidural Abscesses (SEA)

Spinal epidural abscesses (SEA) occur in approximately 19.6 patients/100,000 per year, and their frequency has tripled over the last 2 decades [Tables 1-3].[13,21] Typical etiologies for SEA include; intravenous drug abuse, diabetes, older age, cancer, chemotherapy, immunological compromise, renal failure, and cirrhosis.[2,16,18,23] Chaker *et al.* (2018) found the classical triad for diagnosing 738 SEA; neck/back pain, fever, and a neurological deficit (e.g. weakness).[2] SEA also frequently resulted in elevated WBC levels (no elevation in some cases where the peripheral WBC and cerebropsinal fluid WBC may remain normal), but classically ESR and CRP levels are increased. Further, Procalcitonin levels (normal 0.05 ng/mL) may be elevated to >2 ng/mL or >10 ng/mL indicating respectively infection, and severe sepsis. Blood cultures are often positive. In most cases the organism is *Staphyloccosus aureus*, but there may be other pathogens (e.g. *Streptococcus*, *Pseudomonas aeruginosa E. coli*, and others). [4,11,13,23] In some cases (e.g. immunosuppression, drug addiction), multiple organisms may appear simultaneously. With appropriate medical/surgical treatment, inflammatory markers should decrease; if they remain high and/or increase, treatment is likely failing.[13,17,23,24] Enhanced MRs remain the study of choice for diagnosing SEA (e.g. typically positive within 2–4 weeks), while CT abnormalities are often more delayed (i.e. positive at 6–10 weeks).[2,5,8,11,16,18,19,24,25] If initial non-surgical management is utilized (i.e. antibiotics alone), it is critical to recognize when this strategy has failed [Tables 2-3].[2,14,16,18] Repeat MR studies should be utilzied to follow/recognize progression of SEA/VO with attendant increased neurological compromise/increased MR cord compression/worsening CT-documented deformity. If studies are interpreted as negative but the patient remains clinically symptomatic, obtaining additional MR studies (under sedation if needed to eliminate motion artifact) and second, third, or more radiological/neuroradiological opinions may be warranted. In Shah's study (2018), there was a 27% (99/367 patients) failure rate for the non-surgical treatment of SEA, largely attributed to 6 independent risk factors (algorithm): an initial motor deficit, a pathological compression fracture, cancer, diabetes, a sensory deficit, and a dorsally located abscess. [16] SEA many be managed utilizing anterior,[3-6,8,11,14,17,21,23,24] posterior,[12-14,17,19,21,23,25] or circumferential procedures[7,23] depending on the location of pathology. Performing early surgery, if patients meet the appropriate criteria, is critical to achieve the best results, and avoid permanent neurological sequelae.[2,3,7,12,14,16,18] Interestingly, Chaker *et al*. study was one of the few that documented that the additonal performance of instrumented fusions doubled the reoperation rate for SEA (e.g. series of 130 patients undergoing laminectomies/fusion vs. 608 laminectomies alone for SEA).[2]

Review of Retropharyngeal Abscesses (RPA)

Cervical retropharyngeal abscesses (RPA) occur in 4.10/100,000 children/year.[9,10] They predominate in the pediatric age group due to their proliferation of retropharyngeal lymph nodes [Tables 1 and 3]. In adults, symptoms of RPA may include; fever, dysphagia, respiratory compromise, torticollis, and the onset of new neurological deficits (e.g. particularly in conjunction with SEA/VO).[9,10,20] These patients are often immunocompromised (e.g. diabetes, cancer, older age), have sustained spinal trauma, and/or local trauma to the oropharynx (i.e. foreign bodies in the retropharyngeal space). The retropharyngeal compartment is defined by the buccopharyngeal fascia anteriorly, prevertebral fascia posteriorly, and bilaterally, the carotid sheaths. Tomita *et al*. and Hoang *et al*. both noted how multiplanar CT and MR studies readily documented prevertebral enhancement

plus retropharyngeal "fluid/other" collections, indicative of RPA often in conjuntion with CSEA and/or cervical VO.[10,20] Differential diagnoses for RPA included; cervical osteomyelitis, CSEA, calcific tendinitis of the longus colli muscle, jugular venous thrombosis, necrotizing fasciitis, sepsis, mediastinitis, and erosion into the carotid artery.[9,10,20] Early diagnosis (e.g. with MR and/or CT) and early surgical treatment were typically critical to avoid respiratory collapse. Most pathogens involved a *Staphylococcus aureus* species, but others included; Beta-hemolytic Streptococci, anaerobic, and/or Gram-negative organisms. In Harkani *et al*. (2001) study of 5 patients with RPA, 4 were treated with endobuccal abscess puncture/culture and antibiotics, while 1 required surgical drainage (diabetic); 4 cultured positive for Staph Aureus, while one was positive for Tuberculosis.[9] For the 11 patients with RPA from the 11 case series involving a total of 15 patients, 10 also had CSEA/VO, while one additional patient had RPA/VO; note all 11 patients required anterior surgical procedures [Table 1].[3-5,8,11,13,15,24]

CONCLUSION

Patients presenting with CSEA and/or cervical VO, with or without RPA typically exhibit fever with elevations of WBC, ESR, CRP, and Procalcitonin, have positive blood cultures, and abnormal early diagnostic MR studies (i.e. within 2–4 weeks). With persistent or increasingly elevated laboratory studies, repeatedly positive blood cultures, and progressive pathological findings on MR studies correlating with worsening neurological deficits, early surgery must be considered to maximize recovery, and limit permanent neurological sequelae along with other attendant morbidity, and mortality.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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