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Systematic Review

Treatment Modalities for Spinal Epidural Abscess: A Systematic Review and Introducing a Novel Minimally Invasive Approach

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Abstract

Introduction: Spinal epidural abscess (SEA) is an uncommon but serious infection that may lead to significant neurological deficits if not promptly diagnosed and treated. This study conducts a systematic review of the current literature to evaluate treatment strategies, including both surgical and nonsurgical approaches. It introduces a novel minimally invasive technique to reduce morbidity compared with traditional open surgery.

Methods: This systematic review was conducted in accordance with the PRISMA 2020 guidelines and evaluated both surgical and nonsurgical treatment strategies for spinal epidural abscess (SEA). We included English-language studies published up to April 2025 that reported original data on SEA management outcomes in human patients. PubMed, Embase, Scopus, and Web of Science were searched using a combination of MeSH and free-text terms. A manual search in Google and Google Scholar was conducted as well. Two reviewers independently screened titles, abstracts, and full texts, extracted data on treatment modalities (surgical vs. nonsurgical), outcomes, and patient characteristics, and assessed study quality and bias using NHLBI tools for observational studies and case series. Any conflicts in opinion were settled through discussion among the reviewers or, when necessary, by consulting a third independent reviewer.

Results: This literature review encompassed 106 eligible studies, spanning from 1957 to 2025. Across the studies, 3143 patients underwent surgical management, and 712 received nonsurgical treatment. Treatment outcomes indicated an average failure rate of 11.7% for surgically treated patients and 34% for those managed non-surgically. Time to symptom resolution, documented in 67 studies, averaged 3.7 months, ranging from several days to over a year.

Conclusion: This systematic review, encompassing 106 studies, reveals that the surgical approach to treating spinal epidural abscess is associated with a markedly lower average failure rate (11.7%) compared to nonsurgical approaches (34%)—even though nonsurgical treatment is typically reserved for milder cases—highlighting the critical importance of timely surgical intervention in reducing mortality, persistent neurological deficits, and relapse.

Keywords: Humans, Epidural abscess, Treatment outcomes

Introduction

Spinal epidural abscess (SEA) refers to an infectious process in which pus collects within the space between the dura mater and the bony-ligamentous structures that form the spinal canal. SEA is a rare condition, with a reported incidence of 0.18-1.96 per 10,000 hospital admissions. Despite recent advances in diagnosis and treatment, SEA continues to carry a high mortality rate, ranging from 4.6% to 31% (1).

The incidence of SEA peaks in the sixth and seventh decades of life and is reported to be twice as high in men as in women. SEA can lead to serious and potentially life-threatening complications. The pressure exerted by the purulent collection on the spinal cord can result in neurological damage, including weakness, numbness, paralysis, and bowel and bladder dysfunctions/incontinence. In severe cases, SEA may lead to anterior spinal cord syndrome, characterized by paralysis, loss of pain and temperature sensation, with preservation of light touch sensation. Furthermore, the infection may disseminate to other areas, causing sepsis, meningitis, or brain abscesses, which can result in seizures, coma, and even death. Rapid diagnosis and treatment of SEA are crucial to prevent serious complications (2).

Systemic risk factors consist of conditions such as diabetes, IV drug use, kidney disease, chronic alcohol use, HIV, cancer, severe obesity, long-term steroid therapy, and bloodstream infections (3, 4). Among infections, *Staphylococcus aureus* is the most common (5), and *Streptococcus* species represent the second most frequently isolated organisms (6). Local factors that increase susceptibility to epidural infections include recent spine injury, prior spinal surgery, and procedures involving intrathecal injections or catheter insertion (7).

Optimal treatment strategies for SEA remain a subject of debate. Immediate surgical decompression followed by prolonged antibiotic therapy continues to be the treatment of choice (4, 8, 9). The primary goals of surgery include decompression, debridement, and biopsy for culture. Surgical intervention is indicated whenever MRI reveals compression of the nerve roots, spinal cord, or dura mater. It is widely accepted that the presence of an epidural abscess warrants emergency treatment before the onset of neurological compression (7). Additional surgical indications include progressive neurological deficits, persistent severe pain, fever, and elevated white blood cell count (5).

Open surgery remains the standard approach; however, traditional procedures are often associated with significant morbidity. As such, there is a growing need for less invasive treatment options (6). Various minimally invasive techniques have been employed in the management of spinal infections. These approaches, which minimize soft tissue damage, are associated with faster recovery and earlier return to functional activity (10-12).

In the present study, we systematically review the literature to evaluate treatment strategies for SEA, including both surgical and nonsurgical approaches, and to guide optimal management.

Methods

This study was structured as a systematic review and carried out following the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (13). The primary objective was to summarize and compare treatment strategies for spinal epidural abscess (SEA), including both surgical and nonsurgical approaches.

Eligibility criteria were defined prior to the review process. Studies were included if they:

1. reported original data on the management of SEA in human patients, regardless of age, sex, or comorbidities.
2. evaluated outcomes of surgical (open or minimally invasive) or nonsurgical treatment modalities.
3. were written in English and published prior to April 2025.
4. provided sufficient detail on patient characteristics, treatment interventions, and clinical outcomes to allow for the extraction of relevant data.

Studies were excluded if they:

1. were duplicates across databases.
2. did not report treatment outcomes or lacked sufficient clinical detail for inclusion.
3. focused exclusively on other spinal pathologies without direct reference to SEA management.

Data extracted from studies were grouped by treatment modality: surgical (including open or minimally invasive interventions accompanied by antibiotic therapy) or nonsurgical (antibiotic or medical therapy alone). Aspiration-only procedures were not considered surgical interventions.

To identify relevant literature, we searched four major biomedical databases, i.e., Embase, PubMed, Web of Science, and Scopus, covering all records from their launch through April 2025. A subsequent manual search of Google and Google Scholar was conducted to identify additional articles not retrieved in the initial search of the four databases.

The search strategy combined Medical Subject Headings (MeSH) and free-text terms, including "spinal abscess," "epidural abscess," "spinal infection," and "treatment." The final set of keywords was refined through expert consultation and is available in (Supplementary Material 1).

The review process followed a structured protocol that included identification, screening, eligibility assessment, and inclusion of studies, as illustrated in a PRISMA flow diagram (Figure 1). All steps were performed independently by at least two reviewers to minimize bias and ensure reproducibility. Initially, titles and abstracts were reviewed, followed by a full-text evaluation of studies that appeared potentially eligible, without the use of any automated tools. Disagreements between reviewers were resolved through discussion; if consensus could not be reached, a third reviewer was consulted.

Data extraction was carried out independently by two reviewers after duplicates had been removed using reference management software (EndNote 2025). Discrepancies were settled through discussion, and a third reviewer was involved when necessary. No automation tools were used, and no study investigators were contacted for additional or confirmatory data.

Data were collected for the following outcomes: treatment failure (generally defined as mortality, recurrence or persistence of infection, neurological deterioration, persistent neurological deficits, relapse, or the need for additional surgery); time to symptom resolution or follow-up duration; and qualitative or quantitative descriptions of recovery. All available results compatible with these outcome domains were extracted from each study, including all measures, time points, and analyses reported.

Other variables for which data were collected included first author, country of origin, year of publication, study design (e.g., case report, case series, and observational study), patient demographics (e.g., mean age and

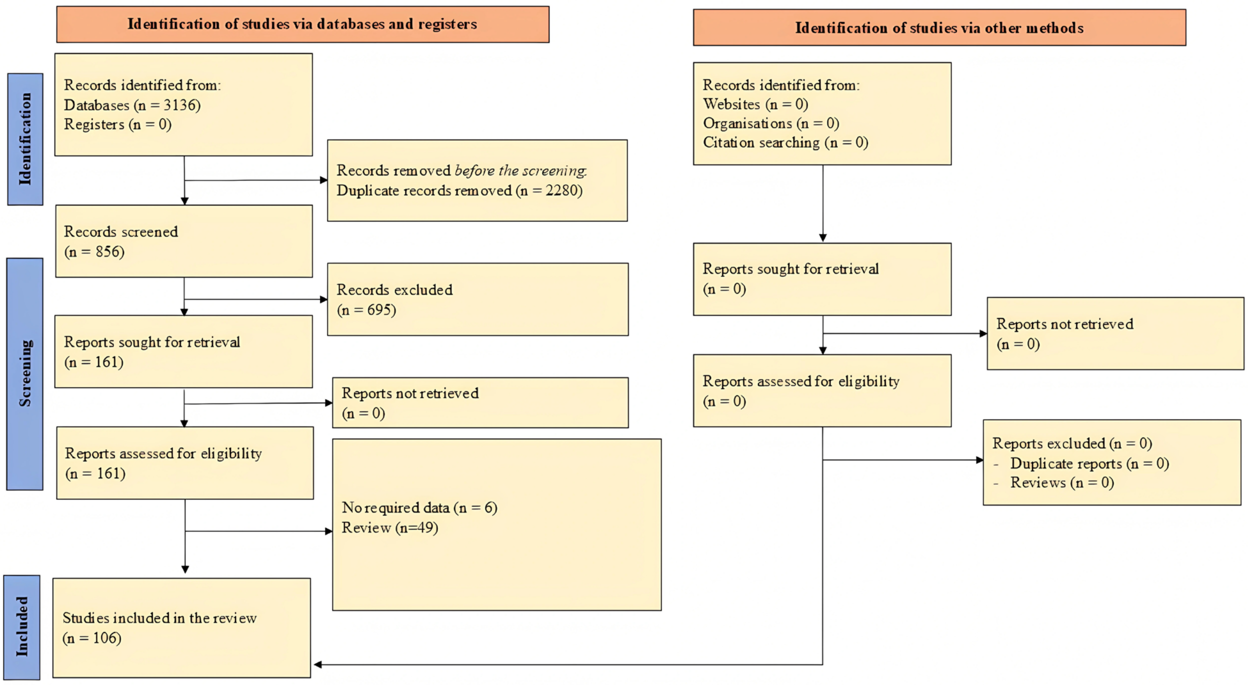

Figure 1. Included studies flow diagram

age range), number of patients undergoing surgical management, number of patients undergoing nonsurgical management, failure rates for surgical and nonsurgical groups (reported as percentages or counts), total failure rate across all patients, definition of poor outcome or failure, and details on follow-up or symptom resolution time. No assumptions were made about missing or unclear information; such data were noted as "not mentioned" (NM) or "not available" (NA) where applicable.

The quality and potential bias of the included studies were independently assessed by two researchers using tools from the National Heart, Lung, and Blood Institute (NHLBI) (available at Study Quality Assessment Tools | NHLBI, NIH). The Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies was used for observational studies, and the Quality Assessment Tool for Case Series Studies was used for case reports and case series. Assessments focused on clarity of objectives, population description, intervention and outcome definitions, follow-up adequacy, and potential bias. No automation tools were used. Complete agreement was reached on assessments, with a third author consulted to resolve any initial disagreements. The complete set of questions utilized is presented in Supplementary Materials 2.

Results

The initial literature search across four databases retrieved 3136 articles. After removing 2280 duplicates, 856 records underwent title and abstract screening. Of these, 695 were excluded for failing to meet the inclusion criteria. Subsequently, 161 reports were assessed for eligibility through full-text review, and 55 were excluded (49 review articles and 6 lacking the required data), resulting in 106 studies included in the final review (1, 8, 14-117). The characteristics of these studies are detailed in Table 1. No additional articles were found during the manual search on Google and Google Scholar.

The 106 studies, spanning publication years 1957 to 2025, included 55 case reports, 19 case series, and 32 observational studies. Observational studies that provided practical information solely through illustrative cases were classified as case reports or case series. These 106 studies originated in diverse countries, predominantly the USA (31), China (19), Turkey (9), Germany (7), Korea (7), and Taiwan (6). Other countries contributed 1 to 4 studies each, with five studies reflecting multi-country collaborations (e.g., Germany–USA, China–USA).

Patient age was documented in 95 studies (89.6%), with a mean age of approximately 53.65 years (range: 30 days to 85 years). Age data could not be retrieved in eleven studies (10.4%). Across the studies, 3143 patients underwent surgical management, while 712 received nonsurgical treatment.

Treatment outcomes varied by management type. Based on reports distinguishing these approaches, the average failure rate was 11.7% for surgically treated patients (3010) and 34% for those treated non-surgically (650), with failure encompassing death, persistent neurological deficits, relapse, or need for additional surgery. The total failure rate across all data, including those that did not report separate failure rates for different treatments, was 15% in 3855 patients.

All surgical interventions were accompanied by antibiotic therapy. Time to symptom resolution was reported in 67 studies, averaging 3.7 months, ranging from several days to over a year, though many provided only qualitative descriptions (e.g., "*recovered within weeks*" or "*improved postoperatively*").

The quality of the included studies was rigorously

Table 1. Characteristics of the included articles

Ref No.	First author	Country	year	Type of study	Age	Number of patients receiving Surgical treatments	Treatment failure in surgical patients	Number of patients receiving only nonsurgical treatments	Treatment failure in nonsurgical patients	Total failure rate	Failure definition	The length of time to resolve the patient's symptoms and resuscitation Follow-up?
Case reports												
14	Chao D (14)	USA	2002	Case report	72	-	-	1	0	0%	No failure	Case: Afebrile, pain reduced after 10 weeks of IV antibiotics; infection resolved on MRI after 6 months of oral antibiotics.
25	Rule R (25)	NA	2021	Case report	NA	1	1	-	-	100%	Poor outcome	Symptoms not resolved
26	Li PS (26)	NA	2010	Case report	NA	1	0	-	-	0%	No failure	NM
27	Latronico N (27)	Italy	1993	Case report	18	-	-	1	0	0%	No failure	Asymptomatic ~1.5 months
28	Pérez-López C (28)	NA	2005	Case report	35	-	-	1	0	0%	No failure	8 Months
29	Cwikiel W (29)	Sweden	1991	Case report	43	-	-	1	0	0%	No failure	2.5 Months
30	Oh JS (30)	Korea	2015	Case report	44	-	-	1	0	0%	No failure	4 weeks
32	Ma F (32)	China	2018	Case report	50	1	0	-	-	0%	No failure	1 Week
33	Chung TT (33)	China	2013	Case report	50	-	-	1	0	0%	No failure	6 Weeks
34	Cao J (34)	China	2022	Case report	58	1	0	-	-	0%	No failure	6 Months
35	Deshmukh VR (35)	USA	2010	Case report	59	1	0	-	-	0%	No failure	1 year
36	Louis A (36)	Canada	2005	Case report	63	1	0	-	-	0%	No failure	Symptoms resolved "shortly after surgery"
37	Chung SY (37)	Taiwan	2005	Case report	64	1	0	-	-	0%	No failure	40 days
38	Oh K (38)	Japan	2019	Case report	68	-	-	1	0	0%	No failure	Abscess resolved ~3 weeks; 12 weeks antibiotics total; Cured at 5 years
39	Ekasari S (39)	Indonesia	2024	Case report	17	1	0	-	-	0%	No failure	After 6 months, the patient had full motor strength
40	Karaja S (40)	Syria	2025	Case report	14	1	0	-	-	0%	No failure	Discharged within 3 days; asymptomatic with complete lesion resolution at 3-week MRI follow-up.
47	de Araujo DB (47)	Brazil	2012	Case report	69	1	0	-	-	0%	No failure	6 Months
48	Araújo F (48)	Portugal	2012	Case report	84	-	-	1	0	0%	No failure	8 Weeks
49	Yang MJ (49)	NA	2024	Case report	69	1	0	-	-	0%	No failure	NA
50	Hsieh A (50)	NA	2018	Case report	73	1	1	-	-	100%	Death	Symptoms not resolved
51	Suengtaworn A (51)	NA	2016	Case report	45	-	-	1	0	0%	No failure	6 Weeks
52	Fan G (52)	NA	2016	Case report	58	1	0	-	-	0%	No failure	2 Months
53	Van Rappard JRM (53)	NA	2015	Case report	NA	-	-	1	0	0%	No failure	8 Weeks
54	Stromich J (54)	NA	2015	Case report	57	-	-	1	0	0%	No failure	NM
56	Lampropoulos C (56)	NA	2012	Case report	70	-	-	1	0	0%	No failure	4 Months
57	Nyberg B (57)	USA	2010	Case report	76	1	0	-	-	0%	No failure	After antibiotic therapy
60	Yazawa S (60)	NA	1998	Case report	67	-	-	1	0	0%	No failure	NA
63	Katzman R (63)	NA	1957	Case report	NM	1	0	-	-	0%	No failure	NA

Table 1. Continued.

Ref No.	First author	Country	year	Type of study	Age	Number of patients receiving Surgical treatments	Treatment failure in surgical patients	Number of patients receiving only nonsurgical treatments	Treatment failure in nonsurgical patients	Total failure rate	Failure definition	The length of time to resolve the patient's symptoms and resuscitation Follow-up?
69	Chima-Melton C (69)	USA	2017	Case report	63	-	-	1	0	0%	No failure	Back pain (the main complaint) improved after several days of antibiotics
72	Soheili M (72)	Iran	2017	Case report	42	-	-	1	0	0%	No failure	12 Months
73	Sales JG (73)	Iran	2013	Case report	15	1	0	-	-	0%	No failure	Symptoms resolved post-op
78	Zhang W (78)	China	2023	Case report	44	1	0	-	-	0%	No failure	1 Month
80	Hsu TL (80)	Taiwan	2022	Case report	85	1	0	-	-	0%	No failure	6 Months
82	Sinnasone S (82)	USA	2024	Case report	50	1	0	-	-	0%	No failure	6 Weeks
83	Soultanis KC (83)	Greece/ USA	2013	Case report	53	1	0	-	-	0%	No failure	Neuro improved 12h post-op, recovered by day 3; Discharged day 23
85	Chen JM (85)	China	2016	Case report	62	1	1	-	-	100%	Poor outcome	Symptoms not resolved
86	Ohno K (86)	Japan	2015	Case report	83	1	0	-	-	0%	No failure	Upper limb paralysis improved post-laminectomy; specific timeline not detailed
87	Altdorfer A (87)	Belgium	2020	Case report	76	1	0	-	-	0%	No failure	3 Months
88	She W (88)	China	2024	Case report	79	1	0	-	-	0%	No failure	Pain relief on the day of surgery; temp typically on day 3.
90	Wessling H (90)	Spain	2003	Case report	59	-	-	1	0	0%	No failure	1 Year
92	Kim SH (92)	Korea	2011	Case report	67	1	0	-	-	0%	No failure	At discharge
93	Frat JP (93)	France	2004	Case report	61	1	0	-	-	0%	No failure	64 Days
94	Yung BCK (94)	China	2000	Case report	32	1	0	-	-	0%	No failure	3 Months
98	Wheeler D (98)	USA	1992	Case report	51	-	-	1	0	0%	No failure	10 Weeks
99	Sawada M (99)	Japan	1996	Case report	53	1	0	-	-	0%	No failure	120 Days
101	Boszczyk BM (101)	Germany	2000	Case report	17	1	0	-	-	0%	No failure	6 Months
104	Baker CJ (104)	USA	1971	Case report	2.5	1	0	-	-	0%	No failure	16 Days
105	Aicardi J (105)	France	1967	Case report	30-day -old	1	0	-	-	0%	No failure	2 Months
107	Jackson F (107)	USA	1964	Case report	17	1	0	-	-	0%	No failure	NM
108	Özyemisci-Taşkiran Ö (108)	Turkey	2007	Case report	54	-	-	1	0	0%	No failure	14 Months
109	Rauchwerger JJ (109)	USA	2008	Case report	46	1	0	-	-	0%	No failure	1 Week
112	Kostanian VJ (112)	USA	2007	Case report	51	-	-	1	0	0%	No failure	3 Months
114	Izci Y (114)	Turkey	2005	Case report	30	1	0	-	-	0%	No failure	NM
116	Kiymaz N (116)	Turkey	2005	Case report	10	1	1	-	-	100%	Poor outcome	Full recovery after second surgery and 7 weeks of IV antibiotics; Asymptomatic at 12 months
Case series												
1	Maslen DR (1)	USA	1993	Case series	67, 68	2	2	-	-	100%	Poor outcome	NM

Table 1. Continued.

Ref No.	First author	Country	year	Type of study	Age	Number of patients receiving Surgical treatments	Treatment failure in surgical patients	Number of patients receiving only nonsurgical treatments	Treatment failure in nonsurgical patients	Total failure rate	Failure definition	The length of time to resolve the patient's symptoms and resuscitation Follow-up?
24	Wu T (24)	China	2024	Case series	50, 57	2	0	-	-	0%	No failure	Case 1: Full recovery (Frankel E) at 3 months. Case 2: Improved to Frankel D by 1 year.
45	Rea GL (45)	USA	1992	Case series	Mean 66	7	1	-	-	14%	Death	6 to 8 weeks for most cases
58	Hernández AG (58)	NA	2008	Case series	All Over 50	4	4	3	3	100%	Poor outcome	Symptoms not resolved
59	El Hajjam M (59)	Morocco	1999	Case series	NA	1	-	4	-	80%	NA	NA
61	Lacerda Gallardo A (61)	NA	1998	Case series	NA	4	3, 1	-	-	75%, 25%	Poor outcome/ mortality	NA
62	Aguado JD (62)	Spain	1992	Case series	NA	2	0	2	2	50%	Death	NA
64	Wang ST (64)	China/USA	2018	Case series	Mean 21.64	2	0	-	-	0%	No failure	NM
65	Kubrakov KM (65)	Republic of Belarus	2019	Case series	Mean 58	5	1	-	-	20%	Death	Pain reduced days 2-3 post-op; Specific resolution time not stated
70	Safavi-Abbasi S (70)	USA	2013	Case series	13, 56, 59	3	0	-	-	0%	No failure	Pts discharged stable; symptoms/MRI resolved at 2–6 months follow-up
74	Hur JW (74)	Korea	2012	Case series	68, 52	2	2	-	-	100%	Poor outcome	Symptoms not resolved
76	Ekici (76)	Turkey	2012	Case series	61, 63	2	0	-	-	0%	No failure	3 Months
77	Papadakis SA (77)	Greece	2023	Case series	Mean 54	4	0	-	-	0%	No failure	3 pts full recovery by 3 months; 1 pt full recovery at 2 years.
96	Schultz KD (96)	USA	2001	Case series	50, 57	2	0	-	-	0%	No failure	Case 1: Improved by day 10, near complete recovery in 2–6 months. Case 2: Mild improvement post-op, discharged soon after.
100	Pfister HW (100)	Germany	1996	Case series	Mean 61	2	1	-	-	50%	Poor outcome	Pt 2: Normal neuro exam at 10 weeks.
102	Leys D (102)	France	1985	Case series	62, 57, 63, 30, 52	-	-	5	1	20%	Poor outcome	6 weeks, 1 month, 3 months, 2 months
111	Muzii VF (111)	Italy	2006	Case series	Mean 54	8	0	-	-	0%	No failure	Mean follow-up 39 months; Spontaneous fusion occurred
113	Daglioglu E (113)	Turkey	2009	Case series	34, 53	2	0	-	-	0%	No failure	Case 1: Symptom-free at 4 years; Case 2: Symptom-free at 6 months

Table 1. Continued.

Ref No.	First author	Country	year	Type of study	Age	Number of patients receiving Surgical treatments	Treatment failure in surgical patients	Number of patients receiving only nonsurgical treatments	Treatment failure in nonsurgical patients	Total failure rate	Failure definition	The length of time to resolve the patient's symptoms and resuscitation Follow-up?
117	Parkinson JF (117)	Australia	2004	Case series	48, 14, 72	3	0	-	-	0%	No failure	Case 1: Improvement over 6 weeks IV Abx. Case 2: Recovery over weeks; 6 weeks of IV Abx; walking at 6 months. Case 3: Resolution after 6 weeks IV Abx.
Observational studies												
8	Savage K (8)	USA	2005	Observational retrospective	Mean 46.3	23	3 (13%)	29	4 (14%)	13.5%	Poor outcome	NM
15	Wang TC (15)	Taiwan	2010	Observational retrospective	Mean 59.7	21	10 (48%)	-	-	48%	Poor outcome	NM
16	Tang HJ (16)	Taiwan	2002	Observational retrospective	Mean 60	25	-	21	-	28%	Poor outcome	Median in hospital stay: 32 days.
17	Roßbach BP (17)	Germany	2014	Observational retrospective	NM	11	1 (9%)	2	0 (0%)	7.6%	Poor outcome	NM
18	Redekop GJ (18)	Canada	1992	Observational retrospective	Mean 52	21	-	4	-	24%, 20%	Poor outcome/ mortality	Up to 36 months
19	Lu CH (19)	Taiwan	2002	Observational retrospective	Mean 54	27	1 (3.7%)	2	0 (0%)	3.4%	Death	NM
20	Lenga P (20)	Germany -USA	2022	Observational retrospective	Mean 82.2	35	5 (14.3%)	-	-	14.3%	90-day mortality	NM
21	Kim SD (21)	USA	2014	Observational retrospective	Mean 60	255	26 (12%)	100	14 (14%)	7.53%	90-day mortality	NM
22	Karhade AV (22)	USA	2019	Observational retrospective	Mean 58.75	633	35 (5.5%)	-	-	5.5%	30-day mortality	NM
23	Danner RL (23)	USA	1987	Observational retrospective	Mean 57.5	28	3 (10.7%)	5	2 (40%)	15.1%	Death	Recovery depended on the duration of neurological deficit (<1.5 days=better prognosis)
31	Ma H (31)	Korea	2012	Observational retrospective	Mean 64	19	6 (31.5%)	16	15 (93.7%)	59.9%	Poor outcome	NM
41	Ju MW (41)	Korea	2015	Observational retrospective	Mean 58.3	33	3 (9%)	15	2 (13.3%)	10.3%	Poor outcome	NM
42	Huang PY (42)	Taiwan	2012	Observational retrospective	Mean 58	16	-	13	-	28%	Poor outcome	NM
43	Davis DP (43)	USA	2004	Retrospective case-control	Mean 47	45	-	18	-	37%, 1.6%	Poor outcome/ mortality	NM
44	Joshi SM (44)	UK	2003	Observational retrospective	Mean 61.1	39	19 (49%)	-	-	49%	Poor outcome	NM
46	Akalan N (46)	Turkey	2000	Observational retrospective	Mean 24.3	36	15 (41.5%)	-	-	41.5%	Poor outcome	Up to 2.6 years
55	Juratli T (55)	NA	2013	Observational retrospective	NA	34	10 (29.4%)	-	-	29.4%	Poor outcome	NA
66	Kitov B (66)	Bulgaria	2017	Observational retrospective	Mean 60.2	16	2 (12.5%)	-	-	12.5%	Death	Mean hospital stays 38.57 days; Symptom resolution time not specified
67	Khursheed N (67)	India	2017	Observational prospective	54	25	-	2	-	37%	No improvement	NM
68	Shweikeh F (68)	-	2017	Observational prospective	Mean 57.9	8	2 (25%)	8	2 (25%)	25%	Poor outcome	NM
71	Pitaro NL (71)	USA	2023	Observational retrospective	Mean 53.44	350	60 (17.1%), 91 (26%)	350	75 (21.4%), 123 (35.1%)	19.2%, 30.5%	30- day and 90- day readmissions	NM
75	Adogwa O (75)	USA	2014	Observational retrospective	Mean 65	30	21 (70%)	52	45 (87%)	80.7%	Poor outcome	NM

Table 1. Continued.

Ref No.	First author	Country	year	Type of study	Age	Number of patients receiving Surgical treatments	Treatment failure in surgical patients	Number of patients receiving only nonsurgical treatments	Treatment failure in nonsurgical patients	Total failure rate	Failure definition	The length of time to resolve the patient's symptoms and resuscitation Follow-up?
79	Dai G (79)	China	2020	Observational retrospective	Mean 63.6	8	4 (50%)	3	1 (33%)	45.4%	Poor outcome	Up to 24 months
81	Du JY (81)	USA	2019	Observational retrospective	Mean 57.1	1094	40 (3.7%)	-	-	3.7%	Post op 30-day mortality	NM
84	Connor DE (84)	USA	2013	Observational retrospective	Mean 51.6	55	12 (21.8%)	17	3 (17.6%)	20.7%	Poor outcome	NM
89	Zimmerer SM (89)	Switzerland	2011	Observational prospective	Mean 57	34	14 (41.6%)	2	0 (0%)	39.2%	Poor outcome	NM
91	Oktenoglu T (91)	Turkey	2011	Observational retrospective	Mean 59.14	12	2 (16.6%)	2	0 (0%)	14.2%	Poor outcome	NM
95	Soehle M (95)	Germany/ Switzerland	2002	Observational retrospective	Mean 62	25	10 (40%), 5 (20%)	-	-	40%, 20%	Poor outcome/ mortality	NM
97	Sørensen P (97)	Denmark	2003	Observational retrospective	Mean 52.5	19	1 (5%)	10	2 (20%)	10.1%	Poor outcome	NM
103	Ericsson M (103)	Sweden	1990	Observational retrospective	Mean 52.4	7	2 (28.5%)	3	1 (33%)	29.8%	Poor outcome	NM
106	McGee-Collett M (106)	UK	1991	Observational retrospective	Mean 47	19	3 (15.7%)	2	1 (50%)	19%	Poor outcome	Up to 6 months
110	Pereira CE (110)	Brazil	2005	Observational retrospective	Mean 47.5	21	0	3	0	0%	No failure	NM
115	Löhr M (115)	Germany	2005	Observational retrospective	Mean 58.5	27	0 (0%)	-	-	0%	No failure	NM

NM: not mentioned; NA: not available.

evaluated using the National Heart, Lung, and Blood Institute (NHLBI) guidelines, specifically employing the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies for observational studies and the Quality Assessment Tool for Case Series Studies for case reports and series. This structured approach enabled a systematic appraisal of methodological strengths and weaknesses, focusing on objective clarity, population description, intervention and outcome definitions, follow-up adequacy, and potential bias.

For the 73 case reports and case series (detailed in Table 2), the assessments revealed a heterogeneous quality profile: 35 studies (47.9%) were rated good, 10 (13.7%) fair, and 28 (38.4%) poor. High-quality studies (e.g., those by Hsu, Araújo, and Yung) excelled in clearly stating objectives (Q1), providing detailed case definitions and population descriptions (Q2), describing interventions comprehensively (Q5), defining valid and reliable outcome measures (Q6), ensuring adequate follow-up lengths (Q7), and presenting well-described results (Q9). These elements contributed to robust reporting, enhancing the reliability of findings on treatment outcomes. In contrast, poor-quality studies (e.g., those by Ohno, Lampropoulos, and Katzman) often faltered in areas like incomplete intervention descriptions (Q5), unclear outcome measures (Q6), inadequate follow-up (Q7), or poorly presented results (Q9), introducing potential biases such as selection or reporting bias. Fair-rated studies showed mixed performance, with strengths in some domains but inconsistencies in others, such as variable follow-up adequacy. Overall, the predominance of good ratings in key descriptive criteria (e.g., Q1 and Q2 were both yes in over 90% of studies) underscores the value of these reports for illustrating rare clinical scenarios. However, the high proportion of poor ratings highlights limitations in methodological rigor, particularly in older publications where reporting standards were less stringent.

The 33 observational studies (summarized in Table 3) generally exhibited stronger methodological quality, with 19 (57.6%) rated as good, 10 (30.3%) as fair, and only 4 (12.1%) as poor. Good-quality studies (e.g., those by Du, Karhade, and Zimmerer) consistently met criteria for clear research questions (Q1), well-defined populations (Q2), prespecified inclusion/exclusion criteria (Q4), prior measurement of exposures (Q6), sufficient timeframes for associations (Q7), clear exposure and outcome definitions (Q9 and Q11), and statistical adjustments for confounders (Q14). These strengths minimize biases and support more generalizable conclusions on treatment failure rates and prognostic factors. Fair-rated studies (e.g., by Collett, Connor, and Oktenoglu) performed well in core areas such as population specification and outcome clarity but often lacked sample-size justification (Q5), repeated exposure assessments (Q10), or blinding (Q12), potentially affecting internal validity. Poor-quality studies (e.g., by Akalan, Danner, and Lu) showed deficiencies across multiple domains, including unclear timeframes (Q7), unadjusted confounders (Q14), and inadequate handling of loss to follow-up (Q13), which could introduce confounding or attrition bias. Notably, observational studies outperformed case reports/series in higher proportions of good ratings, likely because of their retrospective or prospective designs, which allow for better control of variables and larger sample sizes. However, common gaps in blinding (Q12, often NR) and exposure reassessment (Q10) reflect inherent challenges

Table 2. Quality assessment of the case report and case series studies

Ref No.	First author	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Overall quality
1	Maslen DR (1)	Yes	Yes	NR	Yes	No	Yes	Yes	NA	Yes	Poor
14	Chao D (14)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
24	Wu T (24)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
25	Rule R (25)	Yes	Yes	NA	NA	CD	CD	CD	NA	CD	Poor
26	Li PS (26)	Yes	Yes	NA	NA	CD	CD	CD	NA	CD	Poor
27	Latronico N (27)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
28	Pérez-López C (28)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Fair
29	Cwikiel W (29)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	No	Good
30	Oh JS (30)	Yes	No	NA	NA	No	Yes	Yes	NA	No	Poor
32	Ma F (32)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
33	Chung TT (33)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
34	Cao J (34)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
35	Deshmukh VR (35)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
36	Louis A (36)	Yes	Yes	NA	NA	No	Yes	CD	NA	No	Poor
37	Chung SY (37)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
38	Oh K (38)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
39	Ekasari S (39)	Yes	Yes	NA	NA	Yes	Yes	CD	NA	CD	Poor
40	Karaja S (40)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
45	Rea GL (45)	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Yes	Poor
47	de Araujo DB (47)	Yes	Yes	NA	NA	No	Yes	Yes	NA	Yes	Good
48	Araújo F (48)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
49	Yang MJ (49)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Good
50	Hsieh A (50)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Good
51	Suengtaworn A (51)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Good
52	Fan G (52)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Fair
53	Van Rappard JRM (53)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Fair
54	Stromich J (54)	Yes	Yes	NA	NA	CD	Yes	Yes	NA	Yes	Fair
56	Lampropoulos C (56)	Yes	Yes	NA	NA	CD	CD	CD	NA	CD	Poor
57	Nyberg B (57)	Yes	Yes	NA	NA	No	No	NR	NA	No	Poor
58	Hernández AG (58)	Yes	Yes	NR	Yes	CD	CD	CD	NA	CD	Poor
59	El Hajjam M (59)	Yes	Yes	NR	No	CD	CD	CD	NA	CD	Poor
60	Yazawa S (60)	Yes	CD	NA	NA	CD	CD	CD	NA	CD	Poor
61	Lacerda Gallardo A (61)	Yes	Yes	NR	Yes	CD	CD	CD	NA	CD	Poor
62	Aguado JD (62)	Yes	Yes	CD	CD	CD	CD	CD	NA	CD	Poor
63	Katzman R (63)	Yes	Yes	NA	NA	CD	CD	CD	NA	CD	Poor
64	Wang ST (64)	Yes	No	NR	Yes	No	No	NR	NA	No	Poor
65	Kubrakov KM (65)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
69	Chima-Melton C (69)	Yes	Yes	NA	NA	Yes	Yes	No	NA	Yes	Poor
70	Safavi-Abbasi S (70)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
72	Soheili M (72)	Yes	Yes	NA	NA	Yes	Yes	CD	NA	Yes	Fair
73	Sales JG (73)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
74	Hur JW (74)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
76	Ekici MA (76)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
77	Papadakis SA (77)	Yes	Yes	NR	Yes	No	Yes	Yes	NA	Yes	Poor
78	Zhang W (78)	Yes	Yes	NA	NA	Yes	Yes	NR	NA	Yes	Fair
80	Hsu TL (80)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
82	Sinnasone S (82)	Yes	Yes	NA	NA	Yes	Yes	CD	NA	No	Poor
83	Soultanis KC (83)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
85	Chen JM (85)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good

Table 2. Continued.

Ref No.	First author	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Overall quality
86	Ohno K (86)	Yes	CD	NA	NA	CD	Yes	No	NA	No	Poor
87	Altdorfer A (87)	Yes	Yes	NA	NA	No	Yes	Yes	NA	Yes	Good
88	She W (88)	Yes	No	NA	NA	Yes	Yes	Yes	NA	Yes	Poor
90	Wessling H (90)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
92	Kim SH (92)	Yes	Yes	NA	NA	Yes	Yes	CD	NA	Yes	Fair
93	Frat JP (93)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	No	Fair
94	Yung BCK (94)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
96	Schultz KD (96)	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Yes	Poor
98	Wheeler D (98)	Yes	No	NA	NA	Yes	Yes	Yes	NA	Yes	Poor
99	Sawada M (99)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
100	Pfister HW (100)	Yes	Yes	No	Yes	Yes	Yes	Yes	NA	Yes	Good
101	Boszczyk BM (101)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
102	Leys D (102)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
104	Baker CJ (104)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
105	Aicardi J (105)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
107	Jackson F (107)	Yes	Yes	NA	NA	Yes	Yes	CD	NA	CD	Poor
108	Özyemisci-Taşkiran Ö (108)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	Yes	Good
109	Rauchwerger JJ (109)	Yes	Yes	NA	NA	Yes	Yes	CD	NA	Yes	Fair
111	Muzii VF (111)	Yes	Yes	Yes	Yes	No	No	Yes	NA	Yes	Poor
112	Kostanian VJ (112)	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	No	Fair
113	Daglioglu E (113)	Yes	Yes	NR	Yes	Yes	Yes	Yes	NA	Yes	Good
114	Izci Y (114)	Yes	Yes	NA	NA	No	Yes	Yes	NA	Yes	Poor
116	Kiymaz N (116)	Yes	Yes	NA	NA	No	Yes	Yes	NA	Yes	Poor
117	Parkinson JF (117)	Yes	Yes	NR	Yes	No	Yes	Yes	NA	Yes	Poor

NR: not reported; CD: cannot determine; NA: not applicable.

Table 3. Quality assessment of observational studies

Ref No.	First author	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Overall quality
8	Savage K (8)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
15	Wang TC (15)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
16	Tang HJ (16)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
17	Roßbach BP (17)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
18	Redekop GJ (18)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	No	Fair
19	Lu CH (19)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	NR	No	Poor
20	Lenga P (20)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	NR	Yes	Fair
21	Kim SD (21)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
22	Karhade AV (22)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
23	Danner RL (23)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	CD	No	Poor
31	Ma H (31)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
41	Ju MW (41)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
42	Huang PY (42)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	Yes	Good
43	Davis DP (43)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	Yes	Good
44	Joshi SM (44)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	no	Fair
46	Akalan N (46)	Yes	Yes	NR	Yes	No	Yes	CD	No	Yes	No	Yes	NR	NR	NR	Poor
55	Juratli T (55)	Yes	Yes	CD	Yes	CD	CD	Yes	CD	Yes	CD	Yes	CD	CD	CD	Poor
66	Kitov B (66)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	Fair
67	Khursheed N (67)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	Fair
68	Shweikeh F (68)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
71	Pitaro NL (71)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good

Table 3. Continued.

Ref No.	First author	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Overall quality
75	Adogwa O (75)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	Yes	Good
79	Dai G (79)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	Fair
81	Du JY (81)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
84	Connor DE (84)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	Fair
89	Zimmerer SM (89)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
91	Oktenoglu T (91)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	No	Fair
95	Soehle M (95)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	NR	NR	Yes	Good
97	Sørensen P (97)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
103	Ericsson M (103)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	Fair
106	McGee-Collett M (106)	Yes	Yes	NR	Yes	No	Yes	Yes	No	Yes	No	Yes	NR	Yes	No	Fair
110	Pereira CE (110)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good
115	Löhr M (115)	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	NR	Yes	Good

NR: not reported; CD: cannot determine; NA: not applicable.

in non-randomized research.

Discussion

Spinal epidural abscess (SEA) is an uncommon disorder caused by infection in the epidural space, which lies between the dura mater and the vertebral column. This space is a potential cavity containing fat, connective tissue, and blood vessels, and it provides a protective cushion for the spinal cord. When infected, it can lead to the formation of an abscess that compresses and damages the spinal cord. The clinical manifestations of SEA may include localized back or neck pain, pyrexia, muscular weakness, and paralysis (118). To prevent severe complications, such as neurological damage, vancomycin is typically initiated empirically pending definitive pathogen identification. The Infectious Diseases Society of America recommends a minimum of 6 weeks of antibiotic therapy, although in many instances, including the present study, treatment has extended beyond this duration (119, 120).

Among the most significant risk factors for developing this disease are diabetes mellitus, intravenous drug abuse, infections (of the skin, spine, lungs, and genitourinary tract), and alcohol abuse (121). In the reviewed articles, 26%, 22%, and 28% of patients had diabetes, intravenous drug addiction, and immunodeficiency, respectively. In their research, Artenstein AW et al. utilized a control group and concluded that diabetes is prevalent among patients (122). Interestingly, in our study, the patient did not have diabetes and had no family history of diabetes.

It is crucial to emphasize the necessity of prompt diagnosis and intervention, as it can lead to severe neurological sequelae and even mortality. Rapid diagnosis and appropriate management are important, and it is a professional responsibility to improve patient prognosis (122, 123). However, typical diagnostic indicators of SEA are not consistently present in all patients and may have low diagnostic specificity (124). This underscores the need for diligence, thoroughness, and attention to detail in diagnosing SEA, as delayed diagnosis and management can occur (125). When encountering patients presenting with back pain and fever, it is imperative to actively consider and exclude the possibility of SEA before the onset of neurological deficits. This diligent approach is crucial to preventing complications and should be a cornerstone of clinical practice. In our cases from the literature, the most frequent site of SEA involvement was the lumbar spine, consistent with previous reports. For diagnosing spinal infections, C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) are important indicators and can be used to monitor treatment efficacy. In this study, the rates for these two tests were notably high. Radiography and computed tomography (CT) scans are rapid and readily available methods that can effectively demonstrate the extent of bone involvement; however, their performance in diagnosing SEA is not as robust as magnetic resonance imaging (MRI). Spinal MRI is the primary choice for diagnosing SEA. When a patient suffers from back pain, neurological deficits, or fever and blood tests reveal elevated CRP and ESR levels, a spinal MRI should be performed as expeditiously as possible. Early diagnosis of SEA can prevent severe complications (67, 126-129). Typical MRI findings include low signal intensity on T1-weighted images, high signal intensity on T2-weighted images, heterogeneous signal, and a thick-walled abscess on T1-weighted images with post-contrast signal enhancement (130).

Some studies have indicated that even with appropriate treatment, some patients may experience long-term neurological complications. For instance, in a study by Redekop GJ et al., 44% of patients with spinal epidural abscess experienced neurological sequelae such as muscle weakness and sensory impairment after treatment (18). This might be because a definitive, universally agreed-upon treatment modality remains elusive, with clinicians holding divergent views on the optimal therapeutic approach. Immediate surgical decompression coupled with a prolonged course of antibiotic therapy is generally considered the treatment of choice. However, certain factors, such as high surgical risk and minimal neurological deficits, may favor nonsurgical management.

In a case described by Van Bergen J (131), the decision was made to forgo surgery, despite the abscess's considerable extent and multiple septations on one hand, and the minor neurological deficit on the other. This decision was predicated on the understanding that surgical intervention would be considered if neurological deterioration occurred. Similarly, Killen M-C (132) reported successful nonoperative management of a 77-year-old patient, with antibiotics leading to complete resolution of the abscess on imaging and full restoration of neurological function. Nevertheless, the clinical assessment showed a slight neurological impairment. Although surgical treatments usually need bone reconstruction and may limit spine movement, they have shown a better success rate, reduced risk of mortality, and shorter recovery times.

Nevertheless, given the successful outcomes of medical management in numerous cases, if a patient presents with no neurological deficit or only a mild deficit, a trial of medical therapy can be initiated, with surgical intervention reserved for cases of non-improvement or clinical worsening. In instances where a patient exhibits severe neurological compromise, immediate surgery is imperative, as the extent of potential neurological recovery remains uncertain. The primary challenge lies in managing patients with mild neurological deficits. Since delayed surgery in such cases may result in a failure rate of up to 40%, recent research has focused on identifying predictors of medical treatment failure (133, 134). Research on optimal treatments for SEA is critically important as it can greatly impact patient outcomes.

Various surgical or medical approaches are employed for the treatment of SEA and to alleviate pressure on the spinal cord, ranging from extensive open surgeries to more minimally invasive techniques. Invasive methods for managing spinal abscesses, while efficacious in achieving drainage of purulent material and spinal cord decompression, are characterized by larger incisions and more extensive tissue manipulation (11). It is important to note that they are associated with a greater potential for complications than minimally invasive alternatives. These complications, including spinal instability, significant hemorrhage, and postoperative pain, should be carefully considered when choosing a surgical approach (135, 136). Conversely, minimally invasive techniques utilizing small catheters for abscess drainage are associated with a reduced complication profile and can demonstrate comparable efficacy (96) (137). In the present study, we employed a minimally invasive approach in a patient diagnosed with SEA and achieved favorable outcomes. In the novel approach adopted within this study, the abscess was evacuated via two minimal incisions, one superior and one inferior to the abscess locus, conjoined with a limited laminectomy restricted to the implicated vertebrae. The resultant cavity was irrigated with saline solution until the effluent was clear. This minimally invasive technique may offer considerable advantages over conventional methods. First, circumscribing the surgical field obviates extensive trauma to adjacent tissues and averts impairment of motor function. Second, by curtailing the number of vertebrae subjected to a laminectomy, the patient does not sustain significant deterioration in motor function, and a more expeditious recovery is facilitated.

While this study offers valuable insights, several limitations should be acknowledged. Reporting quality was inconsistent throughout the studies. Many lacked precise definitions of treatment failure, explicit follow-up durations, or comprehensive outcome data, which complicated cross-study comparisons and precluded definitive conclusions. Different patients may have undergone varying types of surgeries, and most observational studies do not report the type of surgery; thus, this information is not reported in Table 1. Lastly, this minimally invasive surgical method was used for the first time in our case, and no similar surgeries were found online. Therefore, further research is needed to evaluate its effectiveness in comparison to other treatment methods.

Application of a Novel Minimally Invasive Technique for Spinal Epidural Abscess Treatment

A 60-year-old male with a history of hypertension was admitted to a prior healthcare center two weeks before referral to our center, with a complaint of neck pain, fever, chills, myalgia, headache, and nausea. He was hospitalized at that time under suspicion of sepsis and was under treatment by broad-spectrum antibiotics: intravenous vancomycin and meropenem; however, sepsis was ruled out following negative blood and urine cultures.

During the second admission, the patient was alert and cooperative. He complained of frequent episodes of neck pain, radiating to all four limbs and shoulders without a clear cause. Since the first admission, the pain had first radiated to the lower extremities and gradually involved the upper extremities—the peak afternoon temperature was 36.9 °C. Upon admission, his oxygen saturation was 97%, heart rate 96 beats per minute, respiratory rate 18 breaths per minute, blood pressure 140/90 mmHg, and blood glucose level 108 mg/dL. Blood and urine cultures had ruled out sepsis during the previous hospitalization. Laboratory examination showed leukocytosis, a CRP level of up to 300 mg/L, and an ESR of 100 mm/h. Other lab values, including Hb and LFTs, were unremarkable and within normal range. He denied any history of intravenous drug use.

The patient exhibited decreased strength in all four limbs, graded 3/5 in the upper extremities and 4/5 in the lower extremities per the MRC (Medical Research Council) muscle power scale. Physical examination revealed extensive tenderness to percussion over the thoracic spinous process with radiating pain to all four limbs. Initial investigations suggested osteomyelitis and spinal empyema of the thoracic vertebrae. Following an MRI scan, a diagnosis of spinal epidural abscess was considered (Figure 2). Given the increase in neurological symptoms on the second day of admission, the patient underwent general anesthesia for "spinal epidural abscess

Figure 2. The abscess can be seen on MRI: T2-weighted sagittal on the left and T1-weighted Axial (post-GAD) on the right

removal, spinal canal decompression, and incision and drainage of the neck abscess."

Following sterile preparation, the patient was positioned prone under general anesthesia with endotracheal intubation. After localization using a C-arm, two separate 3 cm incisions were made. The first incision was at the level of T1-T2 (at the site of the abscess to access the lamina and facet joints), and the second was at the level of T9-T10. The muscles were dissected step by step, followed by a single-level laminectomy at both incisions. Subsequently, a lateral partial corpectomy was performed to facilitate anterior access, and any purulent discharge or abscess observed was sent for culture. A large volume of thin, yellow fluid was drained, and samples were sent for bacterial culture and antibiotic sensitivity testing. After copious irrigation, water flow was established from under the dura mater from the first to the second incision. During the procedure to remove pus in the spinal canal, complete spinal canal decompression was necessary while protecting the dura mater to prevent the entry of pus into the subarachnoid space and the development of subarachnoid infection. The epidural space was examined for possible abscess extension.

A drainage catheter was inserted into the epidural space, above and below the central abscess cavity centered at the laminectomized vertebra. The tip of the catheter definitely reached two vertebrae above and two vertebrae below the laminectomized vertebrae. Serum was injected through the catheter to wash out any remaining infection. A nasogastric tube, along with the catheter, was inserted into the epidural space to allow for continuous postoperative irrigation. Before closure, a final check of the dural sac (outer covering of the spinal cord) was performed to ensure no residual pressure or epidural abscess remained. Then, decortication of the transverse processes was performed laterally at the laminectomized vertebrae, and bone fragments were placed on the sides of the vertebrae and in the corpectomy space for fusion. Neuromonitoring and posterior arthrodesis were performed. After irrigation and hemostasis, a drain was placed and secured separately at each incision site. The muscles were repaired in anatomical layers to ensure proper healing and minimize the risk of postoperative complications. The surgery was completed with skin sutures and a sterile dressing. Postoperatively, the patient was moved to the neurosurgical intensive care unit for close monitoring and comprehensive management, including mechanical ventilation, anti-infective therapy with intravenous cloxacillin and vancomycin, supportive care with neurotrophic medications, and continuous drainage via a negative-pressure tube, to ensure his comfort and safety during the critical recovery period.

Gentamicin injections (80 mg, TDS) were administered postoperatively. An MRI scan was performed 4 days postoperatively to confirm the complete resolution of the spinal epidural abscess. Postoperative neurological examinations were conducted to assess any sensory-motor deficits. After confirmation of infection clearance in 4 days, the drainage catheters were removed.

Prior to admission, the patient had weakness in all four limbs. The muscle weakness resolved immediately after surgery, and the patient was prescribed 30 sessions of physiotherapy, which he completed. This was to help him regain strength and mobility in his limbs after the surgery.

The patient was discharged four days after surgery with oral prescriptions for clindamycin (300 mg, TDS) and cloxacillin (500 mg, TDS) for 2 weeks. A cervical spine MRI performed on the day of patient discharge showed complete resolution of the abscess signal in the spinal canal (Figure 3). Four days after surgery, the patient still had mild paresthesia and cold sensations in the lower extremities below the knees. Three weeks post-surgery, the patient was able to get out of bed wearing a neck brace and move independently. At six months follow-up, the patient exhibited grade 5 muscle strength, no motor impairments, and no signs of abscess recurrence. However, he still reported mild paresthesia and a cold sensation in his lower extremities from the knees down.

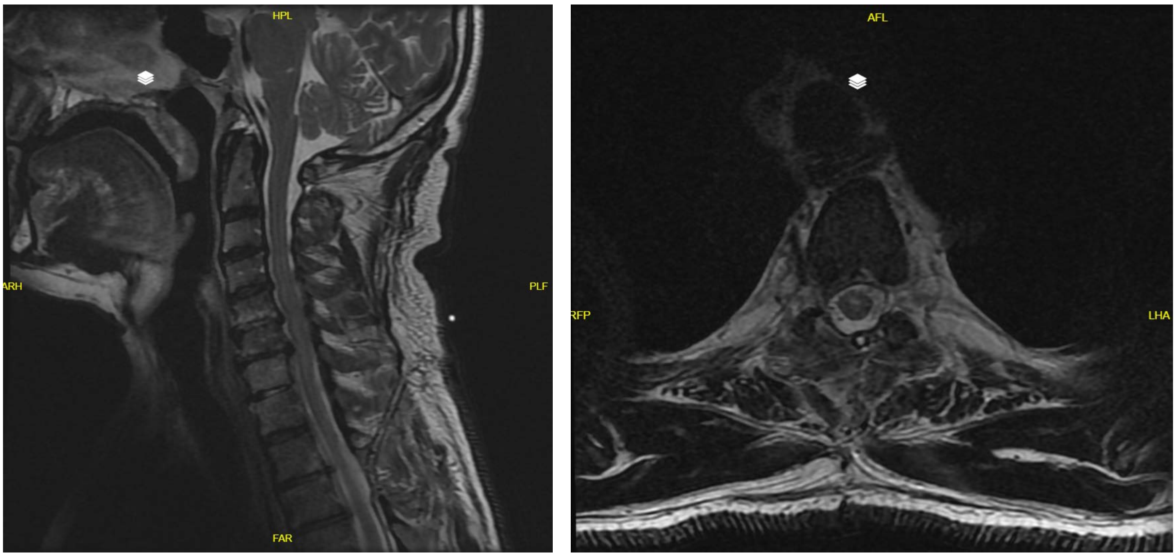

Figure 3. Resolved abscess in T2-weighted sagittal on the right and T2-weighted axial

In this reported case, despite the complete resolution of neurological symptoms immediately post-surgery, the patient reported mild paresthesia and a sensation of coldness in the lower limbs. This observation suggests that the nerve damage caused by the abscess may not be entirely resolved. Therefore, meticulous and long-term follow-up is essential for assessing neurological recovery and timely diagnosis and management of potential complications. Furthermore, our findings suggest that appropriate surgical techniques, such as complete spinal canal decompression and thorough irrigation with antiseptic solutions, may be highly effective in reducing the risk of complications and improving the patient's prognosis. Additionally, using a drainage catheter for continuous postoperative irrigation of the epidural space can facilitate complete infection clearance and prevent abscess recurrence. Our findings are consistent with previous studies demonstrating that decompressive surgery combined with antibiotic therapy is the treatment of choice for SEA (138).

Conclusion

This systematic review, encompassing 106 studies across more than six decades, reveals that surgical management of spinal epidural abscess is associated with a markedly lower average failure rate (11.7%) compared to nonsurgical approaches (34%)—even though surgical treatment is typically reserved for milder cases—highlighting the critical importance of timely surgical intervention in reducing mortality, persistent neurological deficits, and relapse.

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Grok 4 was used for paraphrasing; however, no part of the text was generated by chatbots initially. Any paraphrased sentence has been evaluated and approved by the authors.

Authors' Contribution

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Software: Iman Chehregani Rad
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Competing Interests

The authors declare that they have no conflicts of interest.

Ethical Approval

None.

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Supplementary Files

Supplementary file 1. Search strategy
Supplementary file 2. Quality assessment questions

References

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