

Infective spondylodiscitis in patients on maintenance hemodialysis: a case series

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ABSTRACT

Infective spondylodiscitis is a rare disease. This case review describes the clinical course, risk factors, and outcomes of adult patients on maintenance hemodialysis who presented with infective spondylodiscitis at a single medical center in Taiwan. There were 18 cases (mean age: 64.9 ± 10.8 years) over more than 10 years. Analysis of underlying diseases indicated that 50% of patients had diabetes, 55.6% had hypertension, 55.6% had coronary artery disease, 22.2% had congestive heart failure, 22.2% had a cerebral vascular accident, 16.7% had liver cirrhosis, and 11.1% had malignancies. Sixty-one percent of patients had a degenerative spinal disease and the most common symptom was back pain (83.3%). A total of 38.9% of patients had leukocytosis, 99.4% had elevated levels of C-reactive protein, 78.6% had elevated erythrocyte sedimentation rates, and 55.6% had elevated levels of alkaline phosphatase. The average hemodialysis duration was 72.8 ± 87.5 months, and 8 patients (44.4%) started hemodialysis within 1 year prior to infective spondylodiscitis. Four patients (22.2%) had vascular access infection-associated spondylodiscitis. The lumbar region was the most common location of infection (77.8%), 44.4% of patients developed abscesses, and Staphylococci were the most common pathogen (38.9%). The mortality rate was 16.7%, all due to sepsis. Thirty-three percent of the survivors had recurrent infective spondylodiscitis within 1 year. Infective spondylodiscitis should be considered in hemodialysis patients who present with prolonged back pain with or without fever. Non-contrast MRI is an appropriate diagnostic tool for this condition. Vascular access infection increases the risk for infective spondylodiscitis in hemodialysis patients.

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Introduction

The incidence of end-stage renal disease (ESRD) has declined since 2006, although its prevalence continues to rise because of improving survival times.¹ Patients with ESRD have an increased risk of hospitalization and mortality. The United States Renal Data System (USRDS) 2015 annual report reported that septicemia and other infections contributed to 12% of deaths in ESRD patients.¹ Bone and joint infections accounted for 1.7% of infection-related hospitalizations in patients receiving in-center dialysis.²



Infective spondylodiscitis, defined as infection of the vertebra and intervertebral disc, is rare in the general population and in ESRD patients. Diagnosis may be delayed due to the insidious onset of symptoms and the rarity of the disease. Thus, diagnosis may occur after

the development of serious complications, such as abscess formation in adjacent tissue, disability, irreversible neurological deficits, or even after death. In this case series, we reported the detailed disease process of infective spondylodiscitis in 18 patients on maintenance hemodialysis (HD). We documented their initial presentations, the methods used for diagnoses, treatments, and clinical outcomes, and then analyzed the association between infective spondylodiscitis and HD.

Materials and methods

Patient selection

This study was conducted by retrospective review of the records of patients who were admitted for infective spondylodiscitis between January 2005 and July 2015 in

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a tertiary medical center in Taiwan (Linkou Chang Gung Memorial Hospital, Taoyuan). All included patients were adults on maintenance HD who received treatment for infective spondylodiscitis in our hospital. Patients were identified according to a discharge diagnosis of “infective spondylodiscitis” and “ESRD” from the hospital records. We excluded patients with post-operative spinal infection, tuberculous spondylodiscitis and relapse pyogenic spondylodiscitis. We also excluded patients who were admitted for infective spondylodiscitis followed by onset of ESRD during hospitalization and those who received HD for fewer than 14 days. We finally included 18 cases.

Baseline characteristics and clinical results

We recorded demographic characteristics, personal medical history, and details of the disease process for all patients. The baseline characteristics included age, sex, body mass index (BMI), smoking status, primary cause of ESRD, and underlying diseases (diabetes mellitus [DM], hypertension [HTN], coronary artery disease [CAD], congestive heart failure [CHF], cerebral vascular accident [CVA], malignancy, autoimmune disease, and degenerative spinal disease). To better understand the details and pathogenesis of infective spondylodiscitis, we recorded each patient’s initial presentations, diagnostic methods, and blood test results (white blood cell [WBC] count, albumin [Alb], C-reactive protein [CRP], erythrocyte sedimentation rate [ESR] and alkaline phosphatase [ALP]). We also documented each patient’s HD access, duration of HD, source of infection, identity of the infectious organism, spinal region with infection, treatment, and outcome. This study was approved by our Institutional Review Board.

Results

Patient characteristics

We retrospectively reviewed the records of 18 adult patients on maintenance HD (Table 1). There were 8 males and 10 females, and the mean (\pm SD) age was 64.9 ± 10.8 years. The primary causes of ESRD included diabetic nephropathy (8 patients, 44.4%), chronic glomerulonephritis (7 patients, 38.9%), gouty nephropathy (1 patient, 5.6%), obstructive uropathy (1 patient, 5.6%), and unknown (1 patient, 5.6%). Analysis of major medical diseases indicated that 50% of patients had DM, 55.6% HTN, 55.6% CAD, 22.2% CHF, 22.2% CVA, 16.7% liver cirrhosis, and 11.1% had malignancy. None of the patients had an autoimmune disease or received chronic immunosuppressive therapy. Most patients

(61.1%) had a degenerative spinal disease, such as a non-traumatic compression fracture, herniated intervertebral disc (HIVD), spondylolisthesis, spinal stenosis, osteoporosis, or spur formation.

Presentation, diagnosis, and blood examination

The most common symptom was back pain (83.3%) (Table 2), and the duration from onset of back pain to diagnosis ranged from 3 days to 6 months. Only 44.4% of patients had fever, but fever was often the chief complaint when seeking medical help. Limb weakness, parasthesia, or pain was present in 38.9% of patients.

Sixteen patients (88.9%) had their diagnoses confirmed by magnetic resonance imaging (MRI), 5 with gadolinium contrast (all before 2011) and 11 with non-contrast MRI. The other 2 patients (11.1%) were diagnosed by gallium scans. Echocardiography was performed in 61.1% of patients to exclude infective endocarditis, and none of them had evidence of valvular vegetation.

Leukocytosis was present in 7 patients (38.9%) at admission, 11 patients (61.1%) during hospitalization, and 3 patients (16.7%) upon discharge. Seven patients (38.9%) never developed leukocytosis. All 15 successfully treated patients had a normalized WBC count before discharge, and all 3 patients who had persistent leukocytosis died.

Seventeen patients (94.4%) had elevated CRP levels (>5.0 mg/mL) upon admission, and there was wide variation in the CRP levels of these patients (114.6 ± 102.4 mg/L). Eight patients (44.4%) had the highest CRP levels during the first 3 days of hospitalization. Almost all of the successfully treated patients had significantly lower CRP levels after medical or surgical intervention, although only 2 patients (11.1%) had normal CRP levels upon discharge.

Data on ESR and ALP were not available for all patients. A total of 78.6% of patients whose ESR was tested had elevated levels, but none of them had a decrease of more than 50% by discharge. A total of 55.6% patients whose ALP was tested had elevated levels; 4 of these patients (80%) had decreased ALP levels after treatment and 1 patient (20%) had a persistently high ALP level.

Hemodialysis duration and access

The average time from initiation of HD to hospitalization was 72.8 ± 87.5 months (Table 3). Eight patients (44.4%) started HD within 1 year prior to a diagnosis of infective spondylodiscitis, 2 patients (11.1%) received HD for 1–5 years, and 8 patients (44.4%) received HD for more than 5 years. Analysis of vascular access

Table 1. Baseline characteristics of patients on maintenance hemodialysis who presented with infective spondylodiscitis.

Case No.	Age (yrs)	Sex	Smoking	BMI	Serum albumin (g/dL)	Primary cause of ESRD	Underlying disease	Spinal Disease
1	74	F	No	22.76	N/A	DM nephropathy	DM, HTN, CAD, CHF, CVA	T12 compression fracture, osteoporosis, vertebroplasty
2	52	F	No	31.96	3.88	Chronic glomerulonephritis	HTN, CAD, CHF, CVA, Breast cancer on Tamoxifen	None
3	68	F	No	22.59	3.70	Chronic glomerulonephritis	Liver cirrhosis	L4 compression fracture, osteoporosis, HIVD
4	50	M	No	23.03	1.80	Unknown	Liver cirrhosis	vertebral operation
5	63	M	2 PPD	25.96	1.74	DM nephropathy	DM, HTN, CAD	HIVD, spine surgery 9 years ago
6	70	M	No	26.50	3.26	DM nephropathy	DM, HTN, CAD	None
7	55	F	No	23.20	N/A	DM nephropathy	DM	None
8	67	F	No	25.68	3.15	Chronic glomerulonephritis	HTH, CAD, CHF, CVA	T1/12 compression fracture
9	48	M	2 PPD	28.03	2.91	Chronic glomerulonephritis	Liver cirrhosis	None
10	64	F	No	22.71	3.08	Chronic glomerulonephritis	None	Osteoporosis
11	60	F	No	21.79	3.16	DM nephropathy	DM, HTN, CAD	None
12	68	M	No	23.83	3.20	Gouty nephropathy	HTN, CAD, CHF, CVA	L3-L3 degenerative spondylolisthesis, spinal stenosis
13	53	M	No	21.90	2.98	Chronic glomerulonephritis	DM, HTN, CAD	Degenerative spinal disease
14	57	M	No	24.43	3.38	DM nephropathy	DM	None
15	78	F	No	23.42	3.27	Obstructive uropathy	Previous cervical and gastric cancer	Degenerative spinal disease
16	76	F	No	21.04	3.35	DM nephropathy	DM, HTN, CAD	HIVD
17	87	F	No	21.33	2.83	Chronic glomerulonephritis	None	Osteoporosis compression fracture
18	79	M	No	26.30	3.17	DM nephropathy	DM, HTN, CAD	None

F: female; M: male; N: nil; PPD: pack per day; BMI: body mass index; N/A: not available; DM: diabetes mellitus; HTN: hypertension; CAD: coronary artery disease; CHF: congestive heart failure; CVA: cerebral vascular accident; HIVD: herniated intervertebral disc.

Table 2. Initial presentation, diagnostic tools, blood examination results, and hospitalization outcomes of patients on maintenance hemodialysis who presented with infective spondylodiscitis.

Case No.	Back pain	Fever	Limb weakness	Diagnostic tools	Initial WBC	Initial CRP	Highest CRP	Discharge CRP	Elevated ESR	Elevated ALP	Hospitalization outcome
1	N	No	No	MRI, C+/-	14,000	51.7	74.1	45.0	Yes	Yes	Discharge
2	Yes, 1M	No	No	MRI, C+/-	6200	14.7	224.8	21.1	No	N/A	Discharge
3	Yes, 6M	No	No	MRI, C-	4500	3.2	3.2	N/A	Yes	Yes	Discharge
4	N	Yes, 1M	No	MRI, C+/-	7100	103.3	103.3	18.8	Yes	N/A	Discharge
5	Yes	Yes, 3D	No	MRI, C-	25,600	171.4	180.5	180.5	N/A	No	Death
6	Yes, 1W	No	No	MRI, C+/-	14,400	244.1	246.1	19.2	Yes	N/A	Discharge
7	Yes, 4M	No	Yes	MRI, C+/-	4800	8.7	227.3	22.5	Yes	N/A	Discharge
8	Yes, 5D	No	Yes	MRI, C-	6100	20.7	20.7	4.1	No	N/A	Discharge
9	Yes, 1M	Yes, 2D	Yes	MRI, C-	2000	183.0	183.0	6.7	Yes	N/A	Discharge
10	Yes, 1M	Yes, 5D	Yes	Gallium scan	11,000	330.7	330.7	39.7	N/A	Yes	Discharge
11	Yes, 1W	No	Yes	MRI, C-	5800	99.4	99.9	9.0	Yes	N/A	Discharge
12	Yes, 3W	No	No	MRI, C-	9700	24.1	138.9	12.5	No	No	Discharge
13	Yes, 5D	Yes	Yes	MRI, C-	10,800	255.4	257.5	85.4	Yes	N/A	Discharge
14	Yes, 3M	No	Yes	MRI, C-	5900	30.4	53.0	53.0	Yes	No	Death
15	Yes, 3D	Yes	No	MRI, C-	28,400	278.0	278.0	17.5	N/A	No	Discharge
16	Yes, 1M	Yes	No	MRI, C-	9700	42.3	42.3	9.14	Yes	N/A	Discharge
17	Yes, 3W	No	No	MRI, C-	7600	135.2	135.2	29.2	N/A	Yes	Discharge
18	No	Yes, 1D	No	Gallium and Bone scan	19,500	63.9	121.9	121.9	Yes	Yes	Death

CRP: C-reactive protein (mg/mL); WBC: white blood cell count (cells/mL); ESR: erythrocyte sedimentation rate; ALP: alkaline phosphatase; D: day(s); M: month(s); MRI: C-: MRI without contrast; MRI: C±: MRI with and without contrast; N/A: not available.

indicated that 5 patients (27.8%) used an arteriovenous fistula (AVF), 4 patients (22.2%) used an arteriovenous graft (AVG), 8 patients (44.4%) used a tunneled cuffed catheter (TCC), and 1 patient (5.6%) used a femoral double lumen (FDL).

Source, location and organism of infection

Vascular access infection-associated spondylodiscitis was present in 4 patients (22.2%), including 1 with an AVG, 2 with TCCs, and 1 with an FDL. The patient

Table 3. Dialysis access and duration, culture results, location of infection, treatment, and outcome of patients on maintenance hemodialysis who presented with infective spondylodiscitis.

Case No.	HD duration (months)	HD access	Source of infection	Blood culture	Tissue culture	Location	Antibiotics	Antibiotic treatment (days)	Surgical treatment	Hospital stay (days)	1-year outcome
1	10.7	TCC	Bacteremia	<i>Enterococcus faecalis</i>	N/A	L1–L3	Ampicillin	35	No	34	Recurrent
2	50.7	AVG	Vascular access	No growth	Coag (–) <i>Staphylococcus</i>	L5–S1	Teicoplanin	42	Yes	49	Recurrent
3	298.3	AVG	Unknown	N/A	N/A	L3–L4	Vancomycin	40	No	3	Resolution
4	261.7	AVF	Bacteremia from wrist cellulitis	Oxacillin-sensitive <i>S. aureus</i>	N/A	L3–L4	Cefazolin plus Gentamicin	30	No, CT-guided drainage	40	Resolution
5	2.2	TCC	Vascular access	Coag (–)	N/A	L4–L5	Teicoplanin	25	No	24	Death
6	0.5	FDL	Vascular access	<i>Staphylococcus S. epidermidis</i>	Coag (–) <i>Staphylococcus</i>	L2–L3	Teicoplanin, Ceftriaxone plus Rifampicin	162	Yes	162	Recurrent
7	76.9	AVF	Unknown	No growth	No growth	L4–L5	Cefazolin, Oxacillin	24	Yes	36	Resolution
8	1.9	TCC	Unknown	No growth	N/A	L3–L5	Vancomycin plus Ceftriaxone	42	No	55	Resolution
9	3.1	TCC	Bacteremia from leg cellulitis	Oxacillin-resistant <i>S. aureus</i>	Oxacillin-resistant <i>S. aureus</i>	T7–T8	Teicoplanin, Daptomycin, Teicoplanin plus Rifampicin	115	Yes	127	Resolution
10	93.3	AVG	Bacteremia	<i>S. epidermidis</i>	No growth	C4–C7	Vancomycin, Teicoplanin	53	Yes	93	Resolution
11	2.6	TCC	Unknown	No growth	No growth	L4–L5	Vancomycin plus Ceftriaxone	23	Yes	35	Resolution
12	93.1	AVG	Unknown	No growth	<i>S. capitis</i> , <i>Aspergillus</i>	L4–L5	Cefazolin, Oxacillin, Ceftriaxone, Ampicillin/subbactam	32	Yes	52	Resolution
13	173.1	AVF	Unknown	<i>Enterobacter cloacae</i>	<i>K. pneumoniae</i> , <i>M. morgani</i> , <i>E. faecium</i> , <i>Penicillium</i> sp.	L3–L5	Vancomycin plus Piperacillin/tazobactam	42	Yes	45	Recurrent
14	106.1	AVF	Unknown	No growth	No growth	L4–L5	Teicoplanin plus Ceftriaxone	25	Yes	26	Death
15	37.9	TCC	Unknown	No growth	No growth	C6–C7	Vancomycin plus Meropenem	55	Yes	55	Resolution
16	82.9	TCC	Vascular access	Alpha-hemolytic streptococci	<i>S. Ludwigensis</i> , Cong (–) <i>Staphylococcus</i>	L3–S1	Ceftriaxone, Teicoplanin (cephalosporin allergy)	46	No	51	Resolution
17	3.5	TCC	Unknown	No growth	N/A	L1–L2	Teicoplanin plus Cefazidime, Teicoplanin plus Imipenem/cilastatin, Vancomycin plus Flomoxef	38	No	50	Recurrent
18	11.9	AVF	Unknown	No growth	N/A	T10–T11	Ceftriaxone, Vancomycin plus Piperacillin/tazobactam	18	No	17	Death

HD: hemodialysis; AVF: arteriovenous fistula; AVG: arteriovenous graft; TCC: tunneled cuffed catheter; FDL: femoral double lumen; N/A: not available.

presented with AVG infection (case no.2) only received antibiotic treatment for her graft infection. There was no abscess formation of graft and she had adequate response to antibiotic. One of the patients with TCC infection (case no.5) shifted dialysis access to his previously created left forearm AVF. Catheter removal was not done due to unstable clinical condition. The other 2 patients (case no.6 and no.16) did surgical removal of dialysis catheters and used temporary FDL during hospitalization. Four patients (22.2%) had bacteremia-related spondylodiscitis, including 2 had cellulitis-related bacteremia. The source of infection was not determined in the other 10 patients.

The lumbar level was the most common site of infection (14 patients, 77.8%); 2 patients (11.1%) had involvement of the cervical spine and 2 patients (11.1%) had involvement of the thoracic spine. Eight patients (44.4%) had complicated abscess formation over the epidural space (75%), psoas muscle (37.5%), and paraspinal area (12.5%).

Staphylococci were the most common pathogens (7 patients, 38.9%) and coagulase-negative staphylococcus, *Coag(-) Staphylococcus*, was the major pathogen in cases with vascular access-related infective spondylodiscitis. *Staphylococcus aureus* infections were noted in all cases that were cellulitis-related. The other infective species were *Enterococcus faecalis*, *Aspergillus*, *Klebsiella pneumoniae*, *Morganella morganii*, *Enterococcus faecium*, and *Penicillium* sp. Two cases (11.1%) had discrepant blood culture and tissue culture results. Blood cultures were performed in 17 patients, and 9 of them had negative results; tissue biopsy and culture was performed in 11 patients, and 5 of them had negative results. All patients who received tissue biopsies were negative for tuberculosis (TB) based on the polymerase chain reaction (PCR) or tissue culture.

Treatment and outcome

All patients received antibiotic treatment, and the average treatment duration of survivors was 51.9 ± 36.1 days. Most of the cases used vancomycin or teicoplanin plus ceftriaxone or extended-spectrum penicillin/ β -lactamase inhibitor or carbapenem as initial antibiotics (Table 3). The aim of empiric treatment was to cover Staphylococci and Gram-negative bacilli.

Ten patients (55.6%) received surgical intervention and 1 patient (5.6%) received CT-guided drainage. The indication of surgical intervention in those cases were spinal instability, abscess drainage for poor controlled infection and progressive neurologic deficits. The methods of operation included laminectomy, discectomy, and debridement of the infected spine in all cases.

Operators also performed anterior inter-body or posterolateral fusion of spine with bone graft and abscess drainage in selected patients. One patient (case no.6) did re-operation during hospitalization for sepsis control. Another patient (case no.9) had long-term neurologic sequelae after surgical treatment. He was bedridden with urinary and stool incontinence after surgical debridement. His neurologic deficit was caused by acute spinal compression from a post-operative hematoma. This patient had an increased risk of bleeding because of liver cirrhosis with coagulopathy and thrombocytopenia.

The mean (\pm SD) hospital stay was 59.1 ± 38.4 days for survivors and 22.3 ± 3.9 days for non-survivors. One patient (case no.3) who stayed in the hospital for only 3 days completed intravenous vancomycin treatment in the outpatient department for 6 weeks. The overall mortality rate was 16.7%, and all 3 deaths were due to sepsis. Among survivors, 5 patients (33.3%) had recurrent infective spondylodiscitis within 1 year. Two of them (case no.1 and case no.2) had identical organisms to in their first events. Blood and tissue cultures were negative in 3 relapsed cases. Two of the relapsed patients (case no.1 and case no.13) received antibiotics treatment only. The other 3 patients (case no.2, case no.6 and case no.17) did surgical debridement. It is mentionable that surgical intervention was not suggested by orthopedics in the first hospitalization course in case no.17.

Discussion

We retrospectively examined 18 cases of infective spondylodiscitis in patients who were on maintenance hemodialysis. Fifty percent of patients had DM, 16.7% had isolated liver cirrhosis, and 61.1% had degenerative spinal disease. A review of the literature indicated that the common risk factors for infective spondylodiscitis are intravenous drug use, uncontrolled or poorly controlled DM, complications from catheter-associated infections, infective endocarditis, prior spinal surgery, and immunocompromised status.³⁻⁵ Urinary tract infection and intra-abdominal infection are also risk factors for infective spondylodiscitis from Gram-negative bacteria following contiguous spread of the pathogen.^{5,6}

Our HD center has 52 dialysis beds in outpatient department that serves about 300 patients, 3900 dialysis sections, monthly. In our HD center, 59.34% of patients use AVF, 29.84% use AVG and 10.82% use TCC as their dialysis access. We also provide 35 dialysis beds for inpatient department that performs 2500 dialysis sections monthly. Patients on maintenance HD are exposed to additional risks due to the need for

repetitive puncture of the arteriovenous shunt, long-term indwelling of a central venous catheter or Gore-Tex graft, and contamination of the dialysate storage or distribution system. A total of 44.4% of our patients had undergone HD for less than 1 year. Fifty percent of patients used a central venous catheter for dialysis, and vascular access-associated spondylodiscitis was present in 22.2% of patients. Notably, none of the patients using an AVF developed vascular access-associated infection. Faria et al. reported that 91% of cases with spondylodiscitis in a HD cohort used a central venous catheter instead of an arteriovenous shunt for vascular access.⁷ Another study reported that establishment of a new central venous dialysis catheter within 6 months prior to diagnosis was a significant risk factor for spondylodiscitis.⁸ Also, ESRD and/or HD might disrupt the innate or the adaptive immune response, resulting in an increased susceptibility to infectious disease.^{9,10}

The most common presentations among our patients were back pain (83.3%) and fever (44.4%). Thus, infective spondylodiscitis should be considered in HD patients with persistent back pain or fever of unknown origin. Patients in our study might have had insidious onset of back pain that took months from initial symptoms until diagnosis, in accordance with previous reports.^{6,11,12} Only one study reported that fever was the most frequent initial presentation, but almost all patients in that study eventually developed back pain during hospitalization.⁷

In our study, 88.9% of patients were diagnosed by MRI and 11.1% by gallium scan. A total of 68.7% of patients received MRIs without gadolinium contrast, and the non-contrast MRIs were also diagnostic for infective spondylodiscitis. Diagnosis of infective spondylodiscitis may be delayed if physicians do not consider the possibility of this disease. Conventional radiographic findings, such as a decreased intervertebral space, blurring of the vertebral endplates, and vertebral body destruction, are not apparent until 2–8 weeks after the onset of the infection.^{12,13} In middle-aged or elderly adults, these findings are insufficient to distinguish infective spondylodiscitis from degenerative spine disease. Therefore, the Infectious Diseases Society of America (IDSA) suggested the use of MRI to confirm diagnosis because an increased T2-weighted signal can differentiate infectious spondylodiscitis from degenerative spinal disease.¹⁴ Use of gadolinium for MRI might lead to systemic nephrogenic fibrosis in patients with renal insufficiency, so ESRD generally receive non-contrast imaging. Recently, positron emission tomography with fluorine-18 fluorodeoxyglucose (F-18 FDG PET) has become another diagnostic tool for diagnosis of spondylodiscitis.^{14–16} The sensitivities of MRI and F-18 FDG

PET for diagnosis of infective spondylodiscitis are nearly 100%.¹⁶

Echocardiography was performed in 61.1% of our patients to exclude infectious endocarditis, and none of them had vegetation. Previous research reported the rate of endocarditis is 2.6% in the general population,¹⁷ but was 18% in a small series of HD patients.⁷

Blood examinations may assist clinicians in diagnosis and monitoring of treatment response. Our analyses of different parameters upon admission indicated the sensitivities were 38.9% for leukocytosis, 99.4% for elevated CRP, 78.6% for elevated ESR, and 55.6% for elevated ALP. In addition, CRP level appeared to be a good indicator of treatment response. A previous study reported that a 50% decrease of CRP level in one week represented good improvement in patients with infectious spondylodiscitis under adequate treatment.¹⁸ It should be noted that CRP levels seldom return to normal in such patients before discharge. Our study showed that ESR was helpful for diagnosis, but was not sensitive enough to monitor treatment response. All patients had declines of less than 50% in the ESR during hospitalization. In patients with ESRD, ALP might be affected by intact parathyroid hormone (i-PTH) and dynamic bone disorder, leading to persistently high levels of ALP.

Previous studies of infectious spondylodiscitis in the general population and in dialysis patients reported that most infections were in the lumbar spine (58–68%), followed by thoracic spine (27–30%), and the cervical spine (5–11%),^{6–8,19} similar to our results (77.8%, 11.1%, and 11.1%, respectively). A total of 44.4% of patients developed abscesses, most commonly in the epidural space (75%). Previous studies of infectious spondylodiscitis reported that *S. aureus* was the most common pathogen, and accounted for 20–84% of non-tuberculous cases.^{6,20,21} The incidence of Staphylococci infection was 38.9% in our population, but there was a relatively low rate of positive cultures: 52.9% had no growth of blood culture and 45.5% had no growth of tissue culture. Moreover, 75% of the febrile patients had positive blood cultures, but only 22.2% of the afebrile patients had positive blood cultures. We also found that 11.1% of patients had different results from blood and tissue culture. Patzakis et al. studied vertebral osteomyelitis and reported that 85% of organisms isolated from blood cultures were also present in biopsy specimens.²² Therefore, we suggest that blood culture and tissue culture should be obtained from all patients with suspected infective spondylodiscitis, if possible.

The average treatment duration of our survivors was 51.9 ± 36.1 days. The IDSA recommends 6 weeks of parenteral or highly bioavailable oral antimicrobial therapy for the treatment of infective spondylodiscitis.¹⁴

Empiric Vancomycin or Teicoplanin and Ceftriaxone may be sufficient to cover *Staphylococcus* and other Gram-negative pathogens. A total of 55.6% of our patients received surgical interventions, and 5.6% received CT-guided drainage. The common indications for surgical intervention in infective spondylodiscitis are uncontrolled sepsis, progressive neurologic symptoms, and spinal instability. Surgical debridement or CT-guided drainage may also be considered in patients with an epidural, paraspinal, or psoas muscle abscess.

A recent review reported the mortality of infective spondylodiscitis ranged from 0% to 11% in general populations.²⁰ The mortality in our HD patients was slightly greater (16.7%). Moreover, 33.3% of our patients had relapses within 1 year. Early diagnosis and effective antimicrobial therapy might improve prognosis. Among our patients, there were no additional deaths within 1 year from diagnosis among patients who received successful treatment. Nevertheless, a recent study revealed that patients with incident infective spondylodiscitis had a 47% greater mortality rate than the general population.²³ In the previous study, comorbidities were the major cause of death at 1 year after diagnosis of disease.

In conclusion, infective spondylodiscitis should be considered in HD patients present with back pain or fever of unknown origin. The initial evaluations include detailed neurologic examinations, laboratory blood tests and spine plain film. Elevated WBC, CRP, and ESR are helpful for the diagnosis. MRI without contrast is an appropriate diagnostic tool for infective spondylodiscitis in HD patients. The recommended empiric antibiotics are vancomycin or teicoplanin plus one kind of anti-Gram negative bacilli agent. We suggest patient to take bed rests until the spinal instability is corrected by surgical treatment and the infection is definitely controlled. We also consult physiatrist for mobilization and rehabilitation. Blood culture is recommended for every patient; tissue culture is suggested unless being contraindicated or intolerable. Our follow-up protocols include WBC and CRP weekly and image study if needed. Patients will receive antibiotics for at least 4–6 weeks. Surgical intervention is suggested if poor controlled sepsis, progressive neurologic symptoms, or spine instability in those patients.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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