CASO CLÍNICO / *CLINICAL CASE*

Espondilodiscite piogénica por *Escherichia coli*, associada a pielonefrite aguda e pneumonia necrotizante

Pyogenic spondylodiscitis due to Escherichia coli associated to acute pyelonephritis and necrotizing pneumonia

/ A. Murinello[1] / R. Luz[1]/ J. Simões[2]
/ H. Damásio[1] / H. Peres[3] / C. Teiga[4]
/ F. G. Almeida[4] / D. Póvoas[1] / A. R. Gomes[1]
/ A.M. Figueiredo[1] / P. Guedes[1]

[1] Medicina Interna 1 do Hospital Curry Cabral – Lisboa, Portugal
[2] Ortopedia do Hospital Curry Cabral – Lisboa, Portugal
[3] Patologia Clínica do Hospital Curry Cabral – Lisboa, Portugal
[4] Radiologia do Hospital Curry Cabral – Lisboa, Portugal

Correspondência:
António Murinello
Avenida Eng.º Ant.º Azevedo Coutinho, Lt 8 r/c dto.
2750-644 Cascais, Portugal
Telemóvel: 91 8626874
96 4685050
e-mail: amurinello@gmail.com
amurinello@iol.pt
antoniomurinello@yahoo.com

/ Resumo

A infecção bacteriana da coluna é rara, muitas vezes diagnosticada e tratada tardiamente. Tem uma incidência anual de cerca de 1:250.000, equivalente a 3–5% das osteomielites. Em 10–15% dos casos a espondilodiscite é exógena, maioritariamente causada por *Staphylococcus aureus*, das quais 2–16% são infecções por *MRSA*, frequentemente infecções nosocomiais relacionadas com cateteres vasculares. As espondilodiscites endógenas resultam geralmente de embolização vertebral séptica originada em infecções sistémicas, sendo igualmente o *Staphylococcus aureus* o agente etiológico mais frequente nestes casos, com incidência variando nas séries entre 30–80%. Factores de risco conhecido de ocorrência de espondilodiscites são a idade avançada, processos invasivos, imunodepressão por doença ou fármacos, doença maligna, diabetes mellitus, endocardite bacteriana, infecção urinária não tratada, infecções cutâneas e dos tecidos moles. Inicialmente a dor é difusa e pouco localizada, condicionando o atraso no diagnóstico. De início são raros outros sinais e a febre só está presente em cerca de 70% dos casos. A elevação acentuada da VSG é no entanto muito comum. A RMN é o método imagiológico preferencial de investigação. No diagnóstico etiológico são importantes o exame cultural das biópsias, hemoculturas e urinoculturas. Reporta-se um caso de espondilodiscite piogénica por *Escherichia coli*, relacionada com bacteriémia associada a pielonefrite aguda e pneumonia necrotizante, numa doente diabética admitida em coma hipoglicémico.

Palavras-chave: Espondilodiscite piogéncia, pielonefrite, pneumonia necrotizante, *Escherichia coli*.

/ Abstract

Pyogenic vertebral infection is rare, often recognized and treated too late. With an annual incidence of around 1:250 000, represents 3%–5% of osteomyelitis as a whole. In 10%–15% of cases spondylodiscitis are exogenous, mostly due to Staphylococcus aureus infection, with MRSA infections reported in 2%–16% of these cases, frequently a catheter-related, nosocomial infection. Endogenous spondylodiscitis usually results from vertebral seeding following systemic bacterial infections. Staphylococcus aureus is also the most common etiologic agent in

these cases, with an incidence varying in series between 30%–80%. Known risk factors for spondylodiscitis are old age, invasive procedures, immunodeficiency by disease or immune suppressor therapy, malignancy, diabetes mellitus, bacterial endocarditis, untreated urinary tract infection, skin and soft tissue infections. Initially diffuse back pain is more common than localized pain, so delaying the diagnosis. Other signs are initially rare. Fever is present initially in only 70% of cases, but marked elevation of ESR is very common. MRI is the investigation method of choice. Positive organism culture from biopsy, blood or urine, are important for the etiologic diagnosis. The authors report a case of ***Escherichia coli*** *pyogenic spondylodiscitis associated with bacteraemia due to acute pyelonephritis and necrotizing pneumonia, in a diabetic woman presenting in hypoglycemic coma.*

Key-words: *Pyogenic spondylodiscitis, pyelonephritis, necrotizing pneumonia, Escherichia coli.*

/ Introduction

Spondylitis is osteomyelitis of the vertebrae, characterized by destruction of the vertebral bodies, starting at the endplates, with secondary intervertebral disc involvement. Spondylodiscitis (SD) is a primary infection of the disc expanding to neighboring vertebrae. The origin of the bacterial infection is seldom clear at diagnosis, because inflammatory changes in both structures are usually seen in x-ray images[1]. A long diagnostic delay of several months is common due to diffuse pain, often leading to an initial erroneous diagnosis of spinal degenerative disease[1]. Other signs due to radicular, meningeal or spinal cord involvement, representing the invasion of epidural space by purulent material, are also initially absent. We must search for general and localized signs of infection in order to treat their original source. In the pre-antibiotic era vertebral osteomyelitis was fatal in about 25% of the patients. Mortality is now rare and the prognosis depends on early treatment that prevents devastating complications. Mean time in hospital ranges from 30-57 days and hospital mortality from 2-17% in several series[1].

Path of infection is either: (1) exogenous: due to operations or injections near the spinal column or to invasive procedure anywhere, or (2) endogenous: most of the cases due to hematogenous spread from distant infections, leading to colonization of one or several vertebral bodies. Blood stream spread is either arterial through the terminal segmental arteries supplying the vertebrae or through the veins due to a reflux in Batson's plexus caused by a pressure increase, namely in urinary tract infections[2]. Rarely lymphogenic origin is implicated. A center of inflammation near the spinal column eventually is the cause *per continuitatem*. Primary focus of infection can be unrecognizable at the time of SD diagnosis[1]. Pyogenic SD occurs in the lumbar (60%), thoracic (27%) and cervical spine (13%) [3]. In drug addicts cervical spine is the predominant affected segment of the spine[4]. Contrary to children, adult subcondral spongy bone is supplied by nutrients and arteries. Arterial trees in both endplates of the superior/inferior vertebrae are the same, allowing small septic emboli towards metaphyseal arteries -mostly in anterior subcondral regions- to cause infarction and osteomyelitis of two adjacent vertebrae and the intervertebral disc, favored in the adult and the elderly due to the abundant and slow-moving blood supply of the vertebrae. Anterior or posterior extension of the infectious process can cause paravertebral or epidural abscesses, with subsequent neurologic loss. Bony collapse can also result in neural compression[5]. Plain radiographs tend to be non informative at first; computed tomography (CT) scan can help but the gold standard for diagnosing SD is magnetic resonance imaging

(MRI), allowing better definition of inflammation and abscesses of the paravertebral and epidural spaces. CT scan is especially useful for guided-biopsy and paravertebral abscess aspiration[6].

/ Clinical report

A 44 year-old unemployed caucasian woman was admitted in the Emergency Ward of our hospital at **June 4th, 2010** due to severe iatrogenic hypoglycemia. She was found comatose at home, her blood level 26mg/dL treated successfully with e.v. hypertonic glucose. She had type 2 diabetes *mellitus* for several years, treated irregularly with metformin and glibenclamide. At the age of nine she had bacterial meningitis. From then on she displayed mental retardation and behavioral abnormalities (aggressiveness, persecutory delusion, auditory/visual hallucinations). She denied personal or familial history of tuberculosis. No epidemiological data was obtained for brucellosis. She was staying alone in a house with very bad hygiene conditions, eating irregularly and living with several stray cats and dogs she brought home. She denied drug habits or blood transfusions, and had no piercings or tattoos. Physical exam: T 38ºC, BP 130/76mmHg, HR 100bpm, RR 24bpm, with no cyanosis or jaundice. She had several untreated dental cavities, but no dental abscesses. Auscultation showed inspiratory crackles at lower lung lobes; normal heart sounds. Abdominal exam was unremarkable. No peripheral edema. Pulse oximetry: 100%. Neurological examination was normal. She was treated with quetiapine at night due to psychiatric abnormalities. Blood tests: anemia of chronic disease (RBC $3.31x10^{12}$/L; Hb 8.9g/dL; MCV 82.8fl; MCHC 32.6g/dL); leukocytes $6.6x10^9$/L (N 71.2%, L 16.8%, E 4.3%, M 7.0%); lymphocytic populations: CD3 80% = $0.89x10^9$/L, CD4 53% = $0.59x10^9$/L, CD8 26% = $0.288x10^9$/L, CD4/CD8 2.04, B (CD19) 12% = $0.133x10^9$/L, NK (CD16+56) 8% = 0.089; platelets $589x10^9$/L; ESR 116mm; C-reactive protein (CRP) 12.2mg/dL; fibrinogen 753mg/dL (175.0-470.0); iron 29µg/dL (37.0-170.0); transferrin 149mg/dL (190-375), saturation 16.23%; normal ferritin; glucose 392mg/dL (65-105) after hypoglycemia correction; HbA1c 10.8% (4.3-6.1); creatinine 0.60mg/dL (0.8-1.50); GFR 90ml/min; total protein 7.1g/dL; albumin 2.74g/dL; protein electrophoresis of "inflammatory type". All other biochemistry tests and thyroid function were normal. The intradermal Mantoux test was negative. Chest X-ray: bilateral lower lobe pneumonic infiltrates. She was admitted to the Infectious Diseases Unit and treated initially with e.v. regular insulin before ressuming oral metformin, and empiric therapy with e.v. clarithromycin and ceftriaxone. A blood culture then showed positive for *ESBL- Escherichia coli* (*E. coli*), susceptible to amoxicillin clavulanate, cephalotin, gentamicin and ciprofloxacin, chlarithromycin being stopped. Neither urine nor sputum cultures were obtained at that time. Echocardiography did not reveal endocarditis. Pending social solutions before discharge the patient underwent psychiatric evaluation to adjust medication and was given paroxetine, alprazolam, olanzapine and quetiapine. He completed a course of clarithromycin (4 days) and ceftriaxone (10 days), and due to clinical improvement, the lung infection was deemed cured. However, when the antibiotics were stopped the patient began to complain of an increasing pain at the lumbosacral spine, either at rest or walking, only mildly relieved by analgesics. No other symptoms or signs were referred. A plain radiography showed irregularity, poor definition and erosion of the inferior endplate of L5 and superior endplate of S1. Thoracic x-Ray revealed small nodular areas on the lower third of the left lung. At **June 24th, 2010** contrast-enhanced CT scan of the lumbar-sacral spine, and **four days later** a thoracic CT scan disclosed: A) Spine: Spondylodiscitis of L5/S1, with partial destruction of vertebral body of L5; involvement of paravertebral and epidural spaces extending to the levels of S2 and L4-L5 (Figs. 1, 2). B) Thorax: bilateral necrotizing pneumonia of the lower lobes, more severe in the left lung where there was a cavity of 20 mm (Fig. 3). The patient

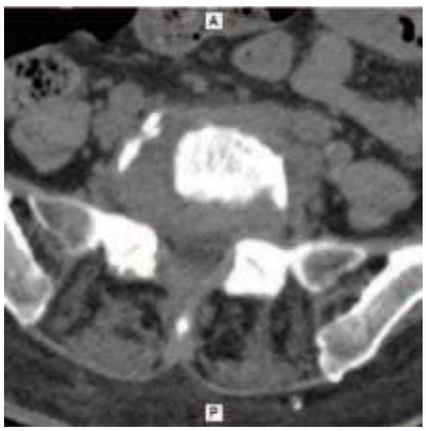


Figure 1: Axial CT: erosion of L5 vertebral endplate; para-vertebral and epidural tissue density/inflammatory tissue.



Figure 2: Sagital reformatted image: erosive changes of inferior L5 and superior S1 vertebral endplates with somatic destruction, enlargement of the disc space and pre-vertebral density/phlegmon.

was transferred to our Unit of Internal Medicine at **June 29th, 2010**. She denied consumption of unpasteurized milk or fresh cheese, and denied previous tuberculosis infection on their own and on her family. She had no fever and stayed apyretic all the time in our Unit. She was unable to walk due to back pain, but had no other symptoms/signs. Blood tests: Hb 10.4g/dL; negative serology for *Brucella,* HBV, HCV, HIV, VDRL. Parasitological exam of feces was negative. Due to urinary retention bladder catheterization was needed. Urine



Figure 3: CT of the thorax: necrotizing pneumonia of the left lower lobe.

was turbid brown, had 500 leukocytes/µL, was nitrite positive, and cultural examination was positive some days later for *EBLS+ E. coli* only sensible to gentamicin, meropenem and nitrofurantoin. According to pneumologist and orthopaedics we decided to delay treatment for some days until bronchoscopy and spinal surgery in order to have collected specimens for cultural exams before starting antibiotics, and because there were no respiratory symptoms and no neurological signs. Bronchoscopy was performed at **July 9th, 2010**: bilateral generalized bronchial hyperemia with purulent secretions, mostly at the lower left bronchus. Its bacterial direct/cultural exam including mycobacterial culture was negative. No malignant cells were found. MRI of the spine was not considered necessary for therapeutic decision. At **July 12th, 2010** spinal surgery was performed through an anterior extra-peritoneal approach, leading to drainage of large volume of pus at the level of the intervertebral disc space of L5-S1. Curettage and lavage of the disc space with removal of osseous and cartilaginous debris was performed. Post-operative aspiration drainage of the disc space was maintained for three days. Cultural exam of the pus was positive for *EBLS- E. coli*, sensible to amoxicillin clavulanate, cephalotin, gentamicin, ciprofloxacin and cotrimoxazole. No malignant tissue was found. Despite two infections by two different strains of *E. coli* (*EBLS+ and EBLS-)* we decided to treat the patient for *EBLS+ E.coli* infection with six weeks e.v. meropenem. **After ten days of bed rest** physiotherapy was initiated, with gradual recovery of muscular strength and the ability to walk. Bone pain improved dramatically and there was no neurologic damage. Chest X-ray was normal by the end of treatment. The urinary catheter was removed. Cultural bacteriological exam of the collected urine was negative at that time and also until the date of discharge. **Three months after admission**, the patient was discharged with her social status sorted out. The results of blood tests at that time were: Hb 10.6g/dL; ESR 81mm; CRP <0.50mg/dL; creatinine 0.8mg/dL. Early post-surgery outcome revealed no back pain or neurologic sequel. Unfortunately, as she went to live in her father's home far away from Lisbon, unable to come back due to financial issues, it was not possible to assess the patient later on. By phone call we understand she is doing well, with no signs of a relapse.

/ Discussion

Infectious SD is caused by bacteria, mycobacterium, virus, fungi or parasites. Common bacterial SD agents include: *Staphylococcus aureus, S. epidermidis, Streptococcus sanguis* and *agalactiae, E. coli, Pseudomonas aeruginosa, Pneumococci, Clostridium perfringens, Proteus mirabilis, Salmonella* spp and *Brucella. Pseudomonas* SD is more common in drug addicts, Gram negative organisms such as *Escherichia, Klebsiella* and *Proteus* in genitourinary infections, *Salmonella* in sickle cell disorders. Potential sources of bacterial SD include invasive procedures, bacteremia in pneumonia, abdominal or pelvic infections, bacterial endocarditis, skin and soft tissue infections, oral cavity infections[7]. *E. coli* infection occurs in variable percentages from 6.6% to 23%, and urinary tract infection in 14% of the cases[5]. A polymicrobial cause is rare, accounting for only 2.5% of cases, usually in sacral osteomyelitis, due to contiguous spread of infection from pressure ulcers. Anaerobic infections occur in 3% of SD and are more typical in diabetes *mellitus*[5]. Predisposing factors for pyogenic SD include old age, multimorbidity, diabetes mellitus, cardiovascular diseases, obesity, renal failure, chronic hepatitis, rheumatic diseases, chronic steroid intake, malignancy, immunosuppressive therapy, preceding systemic diseases, prior tuberculosis, previous visceral operations, sickle cell anemia, drug abuse, and HIV[3]. In around 5% of patients, a history of blunt trauma to the spinal column can be elicited. Approximately 37% of pyogenic SD will not have an identifiable source[5].

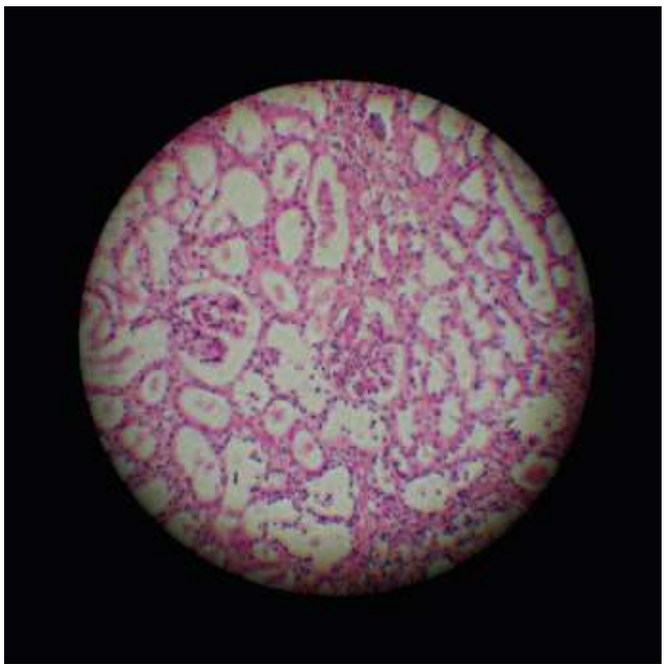
The course of pyogenic SD may be, acute, subacute or chronic (insidious), and lack of specific symptoms may delay diagnosis[8]. SD often presents with diffuse or localized back pain (from mild discomfort to very severe pain), and shoulder pain in cervical SD. Additionally, neurological signs can develop: radicular, meningeal or spinal cord involvement, including radiating pain of nerve root origin, sensory disturbance, segmental weakness, reduction of tendon reflexes, urinary retention[9]. Fever occurs in 70% of cases, 45% suffer from night sweats, and in a few cases anorexia and weight loss. The clinical examination should look for local changes and detailed neurological status. It is typical to have pain on heel strike, impaction, and percussion, but little local pain on pressure. A relieving posture to avoid stressing the ventral sections of the spinal column is a common occurrence. Mostly painful are inclination and re-erection[1].

Hematological abnormalities may include raised white blood count, anemia of chronic disease, abnormal liver function tests and derangements of urea and electrolytes in 27% of cases. A feature

usually found is marked elevation of ESR >100mm (64% of cases) and of PCR[1]. Conventional x-ray is unreliable in the early phase of SD, as skeletal changes are less than obvious. CT scan is usually inferior to MRI for diagnosis of SD but provides a better image of bone destruction and good images of paravertebral abscesses with e.v. contrast medium. CT scan permits guided biopsy of the spine and adjacent phlegmons[10]. The earliest sign of pyogenic SD on MRI is a slight hypersignal in T2, followed in time by hypointensity in T1 and hyperintensity in T2, associated with an increase in inflammatory cells infiltrate and of free water and medullar replacement in the disc and adjacent vertebral bodies. After gadolinium infusion T1-weighted scans may show enhancement at the endplate/disc interface fairly early in the course of the infection[11]. Enhancement will spread away from the disc as the destructive process progresses. Signs of destruction of the endplates occur later in time[3]. MRI clearly defines inflammation of the paravertebral and epidural soft tissues and the development of abscesses[5]. The bone destruction stage can be classified radiographically as: (1) early stage (narrowing of the disc space); (2) destructive stage (bone destruction, collapse of softened vertebrae, and bone proliferation); (3) osteosclerotic stage (new bone formation and osteosclerotic changes).

Possible complications of the evolution of SD vary with the level of the spine involved and are related with extension of the process to the surrounding tissues[5]. Spinal cervical infections can occasionally lead to a pharyngeal abscess, and thoracic spinal infection can be complicated by mediastinitis. At any spine level of the infection, epidural abscess, subdural abscess, meningitis, loss of lordosis at cervical/lumbar levels, segmental collapse with spinal instability and progressive neurological impairment, may complicate SD[5]. As long-term sequelae of SD Kourbeti IS[12] refers 33% rate of spinal dysfunction and 3% of severe dysfunction, at a median of 5.4 years after treatment. Walking ability was restored in 76% of patients. A worse outcome usually is consequence of diagnostic delay and associated chronic debilitating diseases. Irreversible paralysis still affects 4-22% of patients with spinal epidural abscess, with long-term rehabilitation often necessary. The percentage of recurrence is 0-7%[1]. A high level of suspicion is essential to obtain an early diagnosis, when the treatment is more simple and effective. In patients with unremitting back pain, constitutional symptoms, paravertebral muscle spasm, limitation of movement and evidence of neurological deficit, SD should be considered especially in the presence of an existing focus of infection and of known risk factors, and immediately proceed to laboratory and imaging studies for confirmation.

Specific antibiotic therapy to the responsible etiologic agent is one of the mainstays of SD therapy. Overall, the pathogen can be detected in 49% to 83% of cases, more often in acute than in chronic cases, and prior systemic antibiotic therapy is one of the main reasons for failing to identify the pathogen[3]. It is important not to start antibiotic therapy before obtaining material for the microbiological diagnosis, except when clinical circumstances dictate otherwise, for instance in patients with neutropenia or severe sepsis[13, 14], in which case empiric broad antibiotic therapy should be started based on the clinician's



best assessment of the likely organism(s), as well as the patient's risk factors. It is good practice to proceed with an empiric treatment with drugs active against *Staphylococcus aureus* and Gram-negative pathogenic agents, and to change the therapy as soon as the responsible agent and its antibiotic sensibility has been identified. A positive blood culture can be expected in 70% of patients not previously treated with antibiotics[7]. A positive urine or sputum cultures in patients with known concomitant pyelonephritis or pneumonia can be helpful for presumptive treatment. Percutaneous CT-guided fine needle puncture of an abscess is an option, but it gives relatively low quantities of tissue, so that pathogens are only successfully detected in about half of the patients[7]. Intra-operative removal of tissue samples is the most reliable method of detecting the pathogen, as it gives relatively large quantities of tissue, pathogen detection rate being then about 75%[1].

The treatment of pyogenic SD is either conservative or surgical, and the goals of treatment are[5]: 1) to relieve pain; 2) prevent or reverse neurologic deficits; 3) eradicate infection; 4) prevent relapse; 5) establish spinal stability. The principles of conservative treatment include: (a) establishment of an accurate microbiological diagnosis; (b) treatment with appropriate antibiotics; (c) spinal immobilization; (d) careful monitoring for clinical and radiographic evidence of spinal instability and progression of infection or neurological deterioration. The role of bed rest and immobilization is very important, especially when there is vertebral destruction. Cervical lesions are the most dangerous, due to risk of tetraplegia. Activity restriction should be continued for 10-12 weeks or until there is radiographic evidence of healing.

The optimal total duration of antimicrobial therapy is unclear, with several therapeutic schemes being used by different authors,

including a period of initial IV therapy followed by oral antibiotics with high bioavailability (fluoroquinolones, clindamycin, linezolid)[1, 5]. After the sensitivity test, our patient was treated for six weeks with IV meropenem, as proposed by Roblot F[15]. Together with clinical response, continuous lowering of CRP levels is a good measure of treatment success. Bettini N[16] also reports good results in conservative therapy with an 85.7% cure percentage, healing occurring by process of fusion, degeneration or *restitutio ad integrum*, with no lasting major peripheral neurological deficit, and just a small number with lower limb dysesthesia. Only 14.3% of patients needed surgery, by either: decompression, abscess drainage, surgical cleaning and stabilization, and decompression and inter-somatic fusion.

Indications for surgical treatment are[5]: 1) failure to respond to conservative therapy; 2) significant or progressive neurologic deficits; 3) large paraspinal abscess with local mass effect or septic emboli; 4) significant osseous disease involving two adjacent vertebral bodies, or >50% loss in single vertebral body; 5) progressive deformity with or without incapacitating spinal pain. To achieve good surgical results it is useful to follow some principles[17]: a) thorough debridement and removal of infected tissue; b) decompression of neural elements; c) restoration of spinal alignment; or d) correction of spinal instability. One of the main aims of surgery for SD is to have access to the infection focus for drainage, removal of necrotic material, and obtaining samples of pus and tissue for bacteriologic and histopathological studies.

Surgical strategies are based on spinal level of infection, on bone and ligament structural lesions and on absence or presence of neurologic signs. The level of infection is important for planning ways of approaching the infected area. An anterior procedure is always performed when it is indicated to drain an abscess and remove necrotic tissues, the approach varying somewhat depending on the level of the infectious focus. The diagnosis of bone and ligament structural lesions is important to detect instability of the spine, evaluate spinal deformities, and help prevent these deformities by surgically stabilizing the spine. When there are neurological signs, it is important to differentiate if they are due to neurologic compression by the abscess or by bone fragments resulting from vertebral destruction, or if they are the result of local inflammatory chemical mediators released in the infective focus[18].

In patients in whom the stability of the spine is only slightly affected, the surgical procedure can be limited only to drainage of the abscess and removal of necrotic tissue, together with antibiotic therapy. When there is instability of the spine it is necessary to proceed to its stabilization even in the acute phase of the disease, usually by way of posterior trans-pedicle fixation. Later on, in the sequel phase of the disease, already with a complete antibiotic course, if there is great bone loss of the vertebral bodies, it can be necessary to perform reconstruction of the anterior spine. In these cases autologous bone grafting is used associated or not with metallic implants[19]. There are some authors who advocate the immediate reconstruction with metallic implants during the active acute phase of the infection. However, this procedure is not consensual, other authors referring the possibility that the metallic implants could act as foreign bodies, thus perpetuating the infection. In our patient we performed only the drainage of the abscess contained by the anterior longitudinal ligament and removal of necrotic tissue. Instability of the affected segment never occurred in our patient.

The primary infection here was probably an acute pyelonephritis due to *ESBL- E. coli* with bacteremia leading to acute necrotizing pneumonia and pyogenic SDs. Unfortunately no urinary culture was done initially. Although pyogenic SD can rarely occur due to previous acute pneumonia, in our patient we think that the very early demonstration of erosive lesions at lumbar-sacral spine was in favor of the existence of another previous infectious causative process. Also *E. coli* pneumonia is uncommon and almost always associated with *E. coli* urinary tract infection causing bacteremia. The urinary culture done in our Unit revealed a positive result for *ESBL+ E. coli*. We think that the occurrence of this strain was the result of the previous antibiotic treatment with ceftriaxone and the selection of this strain. Since we do not have the possibility to do bacterial genetic studies in our hospital, it is very difficult to prove our hypothesis. Anyway the increasing occurrence of several types of nosocomial infections in our hospital favors our reasoning.

To the best of our knowledge there is no report of clinical cases of SD due to *E. coli* in portuguese literature. Ribeira[20] in a review of the experience of physiotherapy treatment of 28 patients with SD in a period of 5 years in Coimbra Hospital Center, refer that despite *Mycobacterium tuberculosis*, *Staphylococcus aureus* and *Brucella* beeing the most common etiologic agents, there was six cases due to *Escherichia coli*, although it was not mentioned the original focus of infection in that group of patients.

/ References

1. Sobottke R, Seifert H, Fatkenheuer G, Schmidt M, Goßmann A, Eysel P. "Current diagnosis and treatment of spondylodiscitis". *Dtsch Arztebl Int* 2008; 105: 181-187

2. Berbari EF, Steckelberg JM, Osmon DR. "Vertebral osteomyelitis, spondylodiskitis and epidural abscess". In Mandell GL, Bennett JE, Dolin R. eds. Mandell, Douglas, and Bennett´s, *Principles and Practice of Infectious Diseases*. (6th ed) Philadelphia; Elsevier Churchill Livingstone. 2005; pg 1326-1328

3. Buttler JS, Shelly MJ, Timlin M, Powderly WG, O'Byme JM. "Non tuberculous pyogenic spinal infection in adults: a 12-year experience from a tertiary referral centre". *Spine* 2006; 31: 2695-2700

4. Vicente L, Valente C, Afonso O, Faria MJ, Barros MS. "Espondilodiscites piogénicas". *Revista Portuguesa de Doenças Infecciosas* 2003; 2: 5-10

5. Skaf GS, Domloj NT, Fehlings MG, Bouclaous CH, Sabbagh AS, Kanafani ZA, et al. "Pyogenic spondylodiscitis: an overview". *J Infect Public Health* 2010; 3: 15-16

6. Rankine JJ, Barron DA, Robinson P, Millner PA, Dickson RA. "Therapeutic impact of percutaneous spinal biopsy in spinal infection". *Postgrad Med J* 2004; 80: 607-609

7. Nolla JM, Arija J, Gomez-Vaquero C, Fiter J. "Spontaneous pyogenic vertebral osteomyelitis in non-drug-users". *Semin Arthritis Rheum* 2002; 31: 271-278

8. Ando N, Sato K, Mitsukawa M, Yamada K, Wakioka T, Nagata K. "Surgical results of percutaneous suction aspiration and drainage of pyogenic spondylodiscitis". *Kurume Med J* 2010; 57: 43-49

9. Hopkinson N, Stevenson J, Benjamin S. "A case ascertainment study of septic discitis: clinical, microbiological and radiologic features". *Q J Med* 2001; 94: 465-470

10. Maiuri F, Iaconetta G, Gallichio B, Manto A, Brizonti F. "Spondylçodiscitis: clinical and magnetic resonance diagnosis". *Spine* 1997; 22: 1741-1746

11. Rothman M, Zaarski G. "Imaging basis of disc space infection". *Semin Ultrasound CT MR* 1993; 14: 437-445

12. Kourbeti IS, Tsiodras S, Boumpas DT. "Spinal infections: evolving concepts". *Curr Opin Rheumatol* 2008; 20: 471-479

13. Grados F, Lescure FX, Senneville E, Flipo RM, Schmidt JL, Fardellone R. "Suggestions for managing pyogenic (non-tuberculous) discitis in adults". *Joint Bone Spine* 2007; 74: 133-139

14. Cottle L, Riordan T. "Infectious spondylodiscitis". *J Infect* 2008; 56: 401-412

15. Roblot F, Besmier JM, Juhel L, Vidal C, Ragot S, Bastides F, et al. "Optimal duration of antibiotic therapy in vertebral osteomyelitis". *Sem Arthitis Rheum* 2007; 36: 269-277

16. Bettini N, Girardo M, Dema E, Cervellati S. "Evaluation of conservative treatment of non specific spondylodiscitis". *Eur Spine J* 2009; 18 (Suppl 1). S143-S150

17. Gasbarrini AL, Bertoldi E, Mazzetti M, Fini L, Terzi S, Gonella F, et al. "Clinical features, diagnostic and therapeutic approaches to hematogenous vertebral osteomyelitis". *Eur Rev Med Pharmacol Sci* 2005; 9: 53-68

18. Gouliouris T, Aliyu SH, Brown NM. "Spondylodiscitis: update on diagnosis and management". *J Antimicrob Chemoter* 2010: 65 (Suppl 3): 11-24

19. Fayazi AH, Ludwig SC, Dabbah M, Bryan BR, Gelb DE. "Preliminary results of staged anterior debridement and reconstruction using titanium mesh cages in the treatment of thoracolumbar vertebral osteomyelitis". *Spine J* 2004; 4: 388-305

20. Ribeira T, Veiros I, Nunes R, Martins L. "Espondilodiscite. Experiência de cinco anos de um Serviço de Reabilitação". *Acta Med Port* 2008; 21: 559-566