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BODY TUBERCULOSIS

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According to the World Health Organization (WHO) data presented in November 2011, one third of the world's population was infected with the TB bacillus. The incidence of new TB cases in 2010 was 9.5 million with 14 million prevalent cases, most of which occurred in the South-East Asia region.

The chief aim of the study was to show the spread of tuberculosis (TB) on renal and bone systems. Also, the paper aims at showing the modern radiology procedures in diagnostics of body tuberculosis.

We examined 33 patients with urogenital tuberculosis and 74 with bone tuberculosis. All patients with urogenital tuberculosis were examined with ultrasound (US) and multi detector computer tomography (MDCT) and few of them with magnetic resonance (MRI). Patient with bone tuberculosis were examined on 16 MDCT.

Urogenital TB – signs of TB infection were found in kidneys, usually one (only in 1 case bilaterally). In two female patients there was a massive infection of ureter, blade and uterus; in one male patient there was a massive infection of ureter, blade, prostate and testis. Out of 77 patients with bone TB, spinal TB was found in 49 cases, in 3 patients in jaws and in 2 cases in tibia; other patients had joint TB.

Body TB can be found in patients with or without lung TB. Modern radiology approach is vital for early diagnosis. *Acta Medica Medianae 2012; 51(1):5-11.*

Key words: *tuberculosis, kidney, bone, MDCT, MRI*

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Introduction

According to the World Health Organization (WHO) data presented in November 2011, one third of the world's population is infected with the TB bacillus. The incidence of new TB cases in 2010 was 9.5 million with 14 million prevalent cases, most of which occurred in the South-East Asia region. An estimated 1.8 million people died from TB in 2010, most in Africa (1). The overall occurrence of extra-pulmonary tuberculosis in children is unknown; however, it is quoted to be between 5% to 10% in children younger than 5 years, of which half of them occur in the spine (2). Renal tuberculosis is a form of TB that is localized to the kidneys and appears as a side effect of a complex primary reactivation, usually lungs. Tuberculosis develops in the renal cortex, from where the infection begins to spread. Caseous granulomas occur in the kidney which may be normal or the size could be increased (putty kidney). Skeletal involvement is usually secondary, with the primary lesion occurring in the chest or genitourinary system. Skeletal manifestations of tuberculosis occur commonly in the spine (3).

The chief aim of the study was to show the spread of tuberculosis (TB) into renal and bone systems. Also, the paper aims at showing the modern radiology procedures in diagnostics of body tuberculosis.

Material and methods

We examined 33 patients with urogenital tuberculosis and 74 with bone tuberculosis. All patients with urogenital tuberculosis were examined with ultrasound (US) and multi detector computer tomography (MDCT) and few of them with magnetic resonance (MRI). Patient with bone tuberculosis were examined on 16 MDCT. There were 18 (54.55%) male and 15 (45.45%) female patients with urogenital tuberculosis, mean age 56 years and 47 (63.71%) male and 30 (36.29%) female patients with bone TB, mean age 35 years.

US examinations were with standard and with color Doppler mode. MDCT was made native and with contrast agent in arterial, venous, parenchymal and MDCT IVU phases for urogenital TB. For bone TB, examinations were made native in the soft tissue mode and in bone plus mode with 3D reconstructions also with contrast agent in parenchymal phase. MRI examinations were performed with T1W, T2W, 3D vibe, FS and with contrast agents.

Results

Characteristics of patients with body TB are shown in Table 1. There were no significant differences in sex, middle age or body mass index

in examined groups. Clinical characteristics of urogenital TB are shown in Table 2. Urogenital TB – signs of TB infection were found in kidneys, usually on one side (97%) and bilaterally in only 3%. In two female patients we found the signs of massive infection of ureter, blade and uterus, also massive infection of ureter, blade, prostate and testis in one male patient. In all patients US examinations and color Doppler were performed. We found dilatation of collector system and thickness of parenchyma with parenchyma destruction and irregularity of the adjacent soft tissue. The diagnosis was made in 18 (54.55%) cases; in other 15 (45.45%) it was not possible. MDCT were performed in all patients, exact diagnoses were found in 30 (90.91%) patients, and in other 3 patients MRI was performed (Table 2). All patients had positive laboratory signs of TB; Koch bacillus was found in all patients (13).

Bone TB – bone TB is usually spinal TB with rare cases of spread in other bones like jaws. Lower thoracic region (25 patients) is the most common segment involved followed by lumbar (12), upper dorsal (6), cervical (4) and sacral (2) regions in decreasing order of frequency. From 74 patients with bone TB spinal TB was found in 49 cases, in 3 cases in jaws and in 2 patients in tibia; other patients had joint TB. All patients were examined by 16 MDCT using bone and bone plus mode and soft tissue mode for detection of lesion in soft tissue. In all patients MDCT examinations were with signs of TB but in 4 cases we performed MRI (Table 3). In all cases Koch bacilli were found. Detectability of methods is shown in Table 4.

Discussion

The evolution of renal tuberculosis occurs in two phases: phase outside parenchymal and urinary phase where hematuria, cystitis, tuberculosis, urinary infection and signs of pyelonephritis install. In kidneys, the lesions appear polymorphic (extensive caseous and ulcerative lesions parenchymal necrosis), the affected kidneys resemble the limestone structures (Figure 1).

Renal tuberculosis can be disseminated and causes the destruction of renal parenchyma that degenerates in hypertension and renal failure (Scheme 1). Symptoms are almost inexistent and the onset is insidious (Figure 2). Early symptoms are pain in the kidneys and bladder and problems with prostate. The general condition is good, but there may be the signs of bacillary impregnation, often feverish, lumbar tenderness and hypogastric sensitivity in men.

Diagnosis is confirmed by the presence of renal tuberculosis Koch bacillus in urine and radiological changes (Figure 3). Renal tuberculosis can be mistaken for kidney stones, kidney cancer, prostate adenoma, chronic pyelonephritis. Diagnosed early, it can be healed relatively quickly. After treatment of renal tuberculosis, medical surveillance is recommended for a period of approximately three years. Renal TB can be the factor for musculoskeletal spread (Figure 4).

Table 1. Main characteristics of examined group of patients

	Female n/%	Male n/%	Age	BMI (kg/m2)
Urogenital TB	15 /33	18 / 28	56.3 ± 5.3	23.3±3.2
Bone TB	30 / 67	47 / 72	35.1 ± 5.1	24.1 ± 4.1
Sum	45 / 100.0	65 / 100.0	45.4 ± 5.2	23.7 ± 3.9

Table 2. Characteristic and diagnostic of urogenital TB

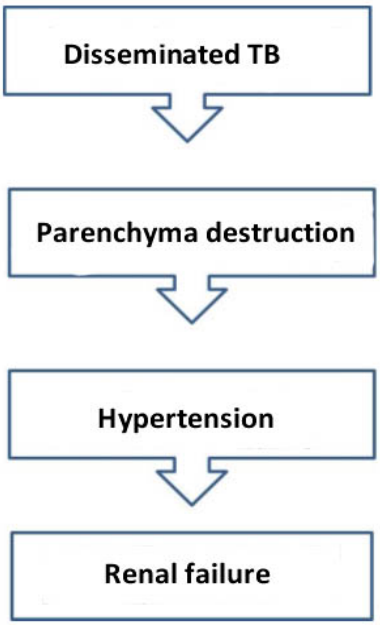
	Females/males	Unilateral renal spread n/%	Bilateral renal spread n/%	US/Color Doppler n/%	MDCT n/%	MRI n/%
Urogenital TB	15 / 18	32 / 97.0	1 / 3.0	18 / 54.5	30 / 90.1	33 / 100.0

Table 3. Characteristics and diagnosis of bone TB

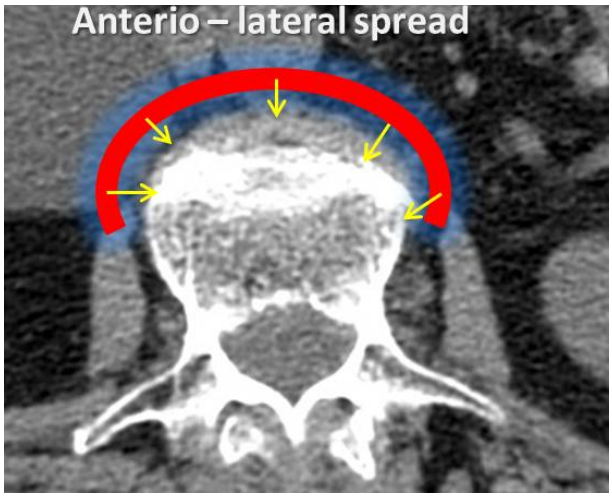
	Females / males	Spinal n/%	Mandibular n/%	Tibia n/%	Joint n/%	MSCT diagnosis n/%
Bone TB	30 / 47	49 / 63.6	3 / 3.8	2 / 2.6	23 / 30.0	77 / 100.0

Table 4. Detectability of various imaging methods

Diagnostic	Urogenital TB		Bone TB	
	Detectability (theory)	Detectability (our)	Detectability (theory)	Detectability (our)
US	> 50%	55%	/	/
MDCT – early	< 10%	/	100%	100%
MDCT – late	100%	91%	/	/
MR after US and MDCT	100%	100%	100%	100%



Schema 1



Schema 2

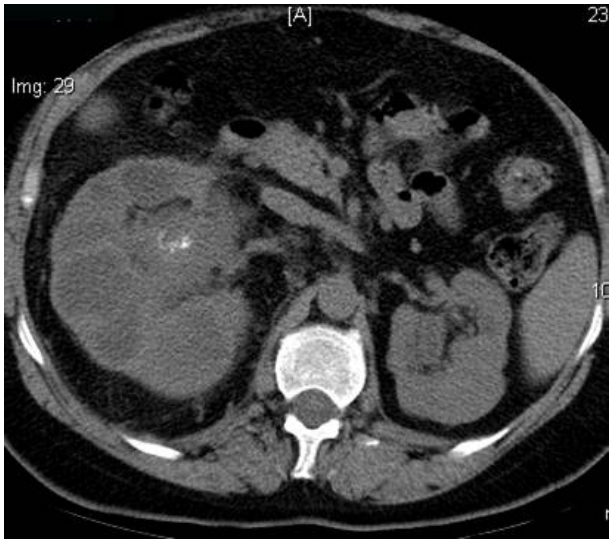


Figure 1. 16MDCT kidney. Disseminated TB in right kidney

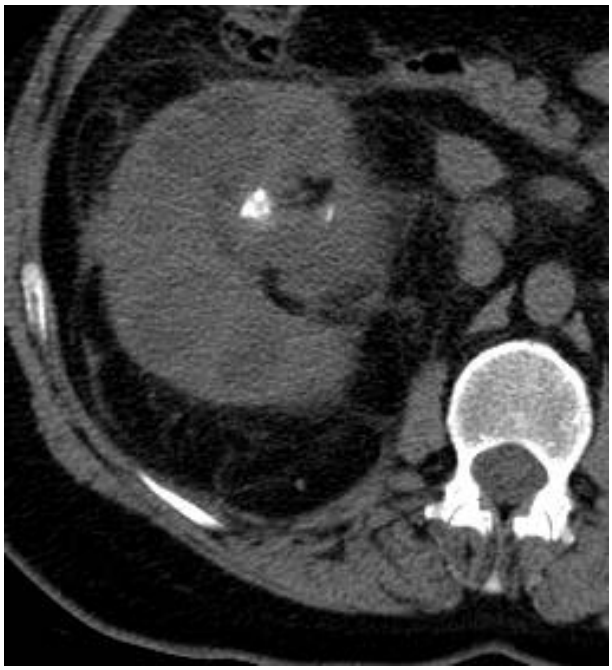


Figure 2. 16MDCT kidney. TB of right kidney

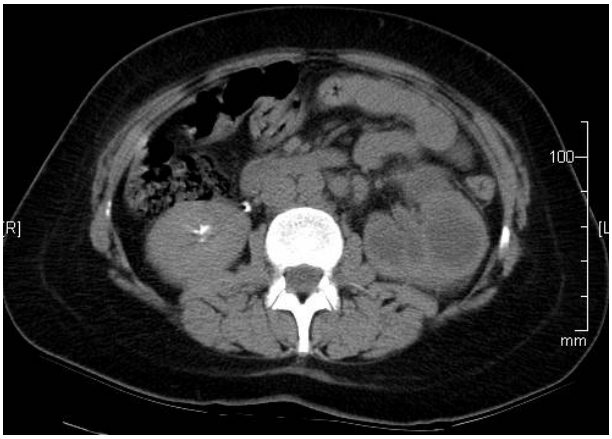


Figure 3. 16MDCT kidney. TB in both kudneys

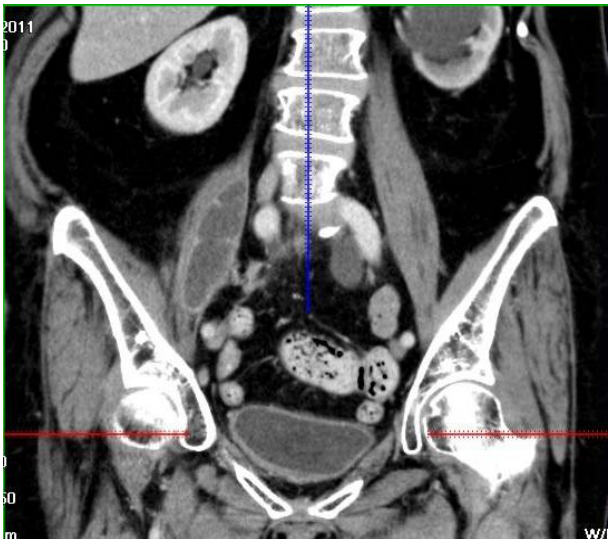


Figure 4. 64MDCT kidney. Apscess in both m.psoas

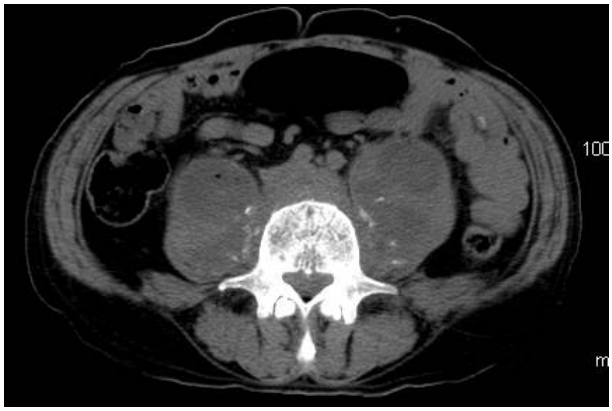


Figure 5. 16MDCT kidney. Disseminated TB

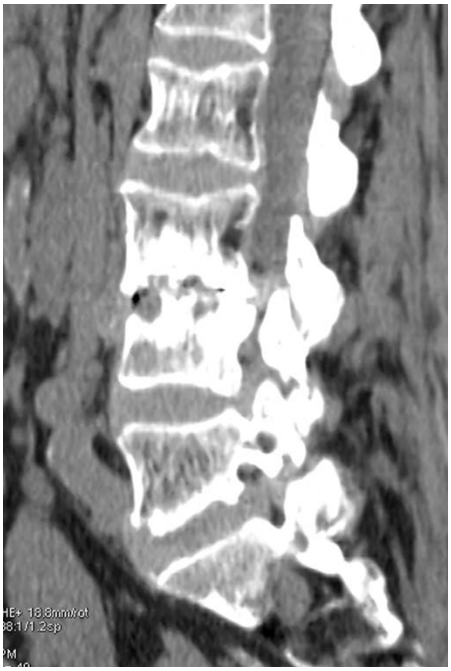


Figure 7. 16MDCT LS spine, standard. Tip A of TB

Evidence of spinal TB dates back to Egyptian times and has been documented in 5000-year-old mummies. Spinal tuberculosis (also known as Pott disease) is one of the oldest demonstrated diseases of humankind. Pott Percivall described the disease for the first time in 1779. Due to discovery of tuberculostatics and improvement in public health, spinal tuberculosis has become rare in developed countries. Affecting the column it can cause significant morbidity, including severe neurological deficits and spinal deformity.

Pott's disease is the most dangerous form of musculoskeletal tuberculosis because it can cause destruction, deformity and paraplegia. Pott's disease affects mainly thoracic and lumbar column. Lower thoracic vertebrae are frequently affected followed by lumbar spine. 10% of cases involve the cervical column. Spinal tuberculosis manifests by back pain, night sweats, fever, weight loss and anorexia. Patients may also develop a spinal mass with parenthesis, tremor, tingling or weakness in the legs mood.

The TB bacilli tend to lodge in highly vascular areas such as the spine. Vascularity coupled with the scarcity of phagocytic cells in this area make it a favorable environment for tuberculosis (4). The infection reaches the skeletal system through vascular channels, generally the arteries, as a result of bacillemia, or rarely in the axial skeleton through Batson's plexus of veins. Simultaneous involvement of the paradiscal part of two contiguous vertebrae in a typical tuberculosis lesion of the spine lends support to the insemination of bacilli through a common blood supply to this region. However, the commoner modes of presentation include:

1. The "central type" of vertebral body disease and "skipped lesions" in the vertebral column is usually due to the spread of infection along Batson's plexus of veins.
2. Typical "paradiscal" lesions are considered to be caused by the spread of disease via the arteries.
3. The "anterior type" of involvement of the vertebral bodies seems to be due to the extension of an abscess beneath the anterior longitudinal ligament and the periosteal, stripping the periosteal from the front and sides of the vertebral bodies (Schema 2). This results in the loss of the periosteal blood supply and destruction of the anterolateral surface of many contiguous vertebral bodies (5).

Two types of bone and joint tuberculosis are recognized: the "caseous exudative" type (Figure 5), which is characterized by more destruction, exudation, and abscess formation, and the "granular" type, which is less destructive, having dry lesions and abscess formation being rare. In clinical practice both types coexist, one predominating the other (Figure 6). Lesions in children are generally of the "caseous exudative type" (5).

The most common mode of presentation in a child younger than 2 years is development of a gibbus, which usually draws the attention of the parents towards a spinal problem. Often, the constant crying of the baby is regarded and treated as "colic". The child may present with inability to sit and preference for lying down, something which is usually unheard of in an active child. The usual symptoms of anorexia or fever may or may not be always present. Under the age of four, backache in children should be regarded as pathological unless and until proved otherwise. Although nonspecific musculoskeletal pain is considered as the most frequent cause, any back pain in a child needs to be assessed and investigated. Most patients usually have a mechanical component to their back pain, and find sitting for prolonged periods quite painful, and are relieved on lying down. They may not have developed a gibbus as yet, but routine radiographs may show early signs of vertebral infection. In countries where tuberculosis is rampant, more than 80% of patients with spinal involvement have some sort of detectable kyphosis at the time of presentation (6).

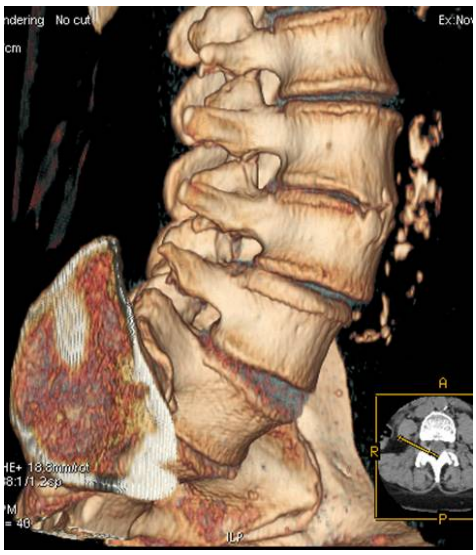


Figure 6. 16MDCT Volume Rendering LS spine. TB on L2 and L3

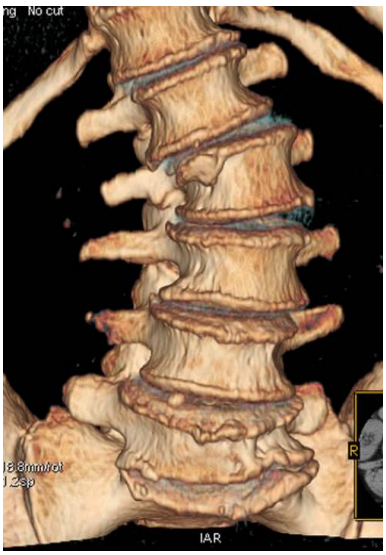


Figure 8. 16MDCT Volume Renderung LS spine. Tip B of TB

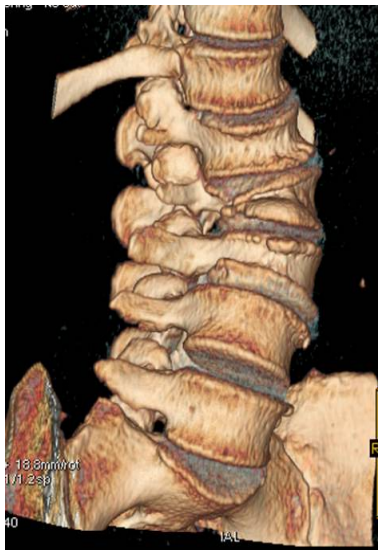


Figure 9. 16MDCT LS spine, volume Rendering. Tip C

Some patients, who have taken treatment for spinal tuberculosis in childhood, may present with deformed spines in their adolescence. The major problem of pediatric spinal tuberculosis is the development of deformity. Tuberculosis causes vertebral body destruction and tends to involve the cartilaginous end-plates. The affliction of the growth plate along with destruction of the anterior portion of the pediatric spine leads to a kyphosis. This deformity is further complicated by an imbalance in the growth patterns, with the posterior growth centers continuing to grow, and the anterior centers not growing.

The status of the posterior column and the type of stabilization undertaken were the main factors determining deformity. The vertebrae can re-stabilize when there is a large contact area on the distal vertebrae (type A re-stabilization), usually seen when the vertebral body is partially destroyed or in the lumbar region (Figure 7). When vertebral destruction is severe, with marked loss of vertebral height, and the patient already has a moderate kyphosis, one or both facets may subluxate or dislocate, with the proximal vertebra stabilizing with point contact on the distal (type-B re-stabilization). The compressive force produces suppression of growth resulting in a deformity of between 40 and 60 degrees. The remaining part of the vertebral body may grow as a wedge (Figure 8).

Type-C re-stabilization occurs when there is severe destruction of the anterior column (Figure 9). The dislocation of both facets leads to a buckling collapse. The proximal vertebral body may rotate up to 90° with its anterior border resting on the distal vertebra. The horizontal vertebrae are spared gravitational forces and hence grow longer, adding to the kyphosis. Buckling collapse is likely to occur in children younger than seven years of age with three or more vertebral bodies affected in the dorsal or dorsum lumbar spine (7-9).

Prognosis also depends upon location of the lesion: those with dorsal lesions have maximal deformity at the time of presentation, partly due to the additive effect of the normal thoracic kyphosis. However, the rib cage offers protection against additional collapse (7). Patients with dorso-lumbal lesions have the worst prognosis as they tend to collapse more during the active phase of the disease and even more during the growth period (7). Those with lumbar lesions have the best prognosis with the least deformity at presentation, a lesser increase during the active phase, and also a tendency for substantial decrease during the growth period (7).

Sometimes, the child may present with a huge epidural or anterior abscess with destruction of the vertebral body, with associated kyphosis. In this situation, decision may be needed to undertake a radical debridement along with reconstruction of the vertebral column. Whenever it can be predicted with reasonable certainty that further growth in the pediatric patient will result in a kyphosis deformity owing to the destruction of one or more vertebral bodies, surgery is indicated. In such situations, the four signs of "spine at risk" by Rajasekaran may also be utilized to arrive at a surgical decision (9). Rajasekaran followed 63 children with tuberculosis and kyphosis for fifteen years and documented the outcome of the kyphosis. Among 100 children with two or fewer at risk signs, 91 had a decrease in the initial kyphosis over time, and none progressed more than ten degrees. Among 100 children with three or more at risk signs, 79 progressed by more than 10 degrees of whom 28 progressed by more than 30 degrees.

The major problem of undertaking radical debridement in children is reconstruction of the large defect with bone graft. Overall, in most cases, owing to the greater length and strength of bone graft required, fibula is chosen over iliac crest or rib (12).

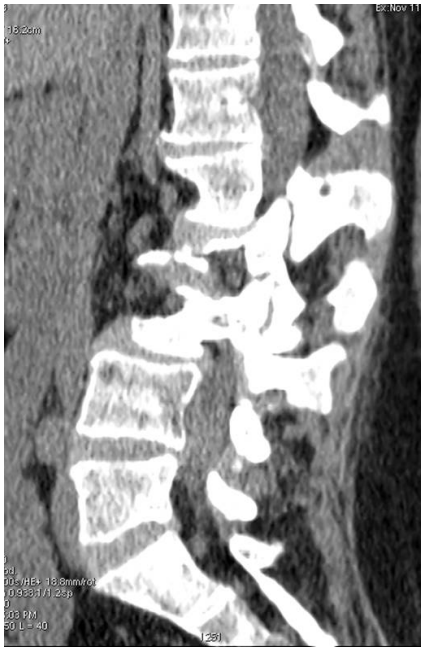


Figure 10. 16MDCT LS spine. Chronic TB of LS part

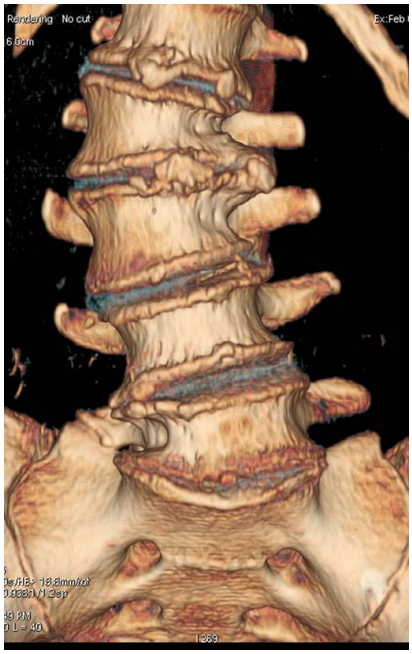


Figure 12. 16MDCT LS spine. Volume rendering. After TB

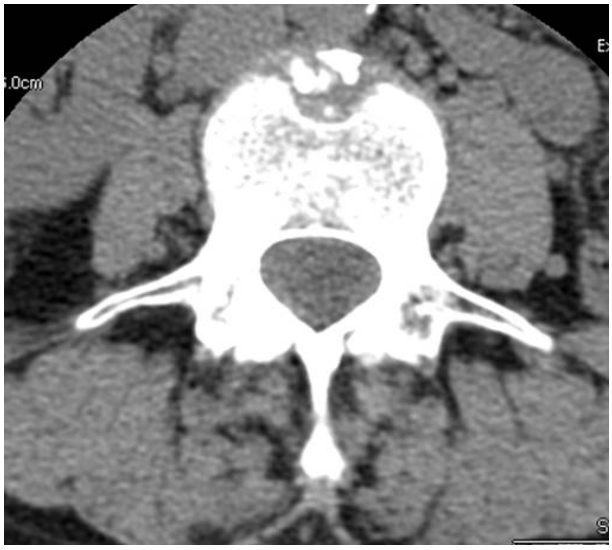


Figure 11. 16MDCT TH LS spine. Antral spread of TB

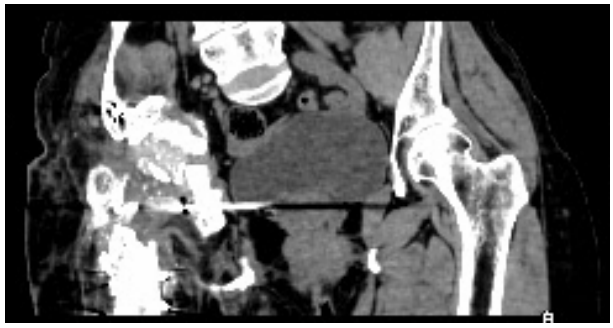


Figure 13. 16MDCT pelvis. Chronic TB with bone destruction

A marked, exudative reaction is common in tuberculosis infection of the skeletal system. A cold abscess is formed by the products of liquefaction and the reactive exudation. It is composed of serum, leucocytes, caseous material, bone debris, and tubercle bacilli. The abscess penetrates the periosteal and ligaments, and migrates or gravitates in various directions, following fascia planes and the sheaths of vessels and nerves. The cold abscess feels warm, although the temperature is not increased to the same extent as in acute pyogenic infections. A superficial abscess may burst to form a sinus or an ulcer lined with tubercles granulation tissue. On aspiration, the contents of the cold abscess range from serous fluid to thick, purulent pus. Following the infection, marked hyperemia and severe osteoporosis take place. The softened bone easily yields under the effect of gravity and muscle action, leading to compression, collapse, or deformation (Figure 10). Necrosis may also be caused by ischemic infarction of segments of bone (Figure 11). Sequestration gives the appearance of coarse sand and rarely produces a radiological visible sequestrum. Because of loss of nutrition, the adjacent articular cartilage may become separated as sequestrum (Figure 12). Some of the radio-logical visible sequestra in tubercles cavities may result from calcification of the caseous matter (Figure 13).

Conclusion

Body TB can be found in patients with or without lung TB. Urogenital TB can be primary but osteomuscular is often secondary, mostly contact spread, usually thoracic but also distant spread into the lumbar or joint regions. Modern radiology approach is vital for early diagnosis. MDCT is a golden standard for diagnostics of bone system, MRI have significant results in diagnostic of para-spinal structures. Meaning of fast and appropriate diagnosis is in prevention of bone deformity or irreversible renal dysfunction.

References

1. World Health Organization. Global Tuberculosis Control: WHO Report; 2011. Available at: http://www.who.int/tb/publications/global_report/2011/gtbr11_main.pdf
2. Dormans JP, editor. Pediatric orthopaedics and sports medicine, the requisites in pediatrics. Oxford: Mosby; 2004.
3. Autzen B, Elberg JJ. Bone and joint tuberculosis in Denmark. Acta Orthop Scand. 1988 ; 59(1): 50-2. [CrossRef] [PubMed]
4. Berney S, Goldstein M, Bishko F. Clinical and diagnostic features of tuberculous arthritis. Am J Med. 1972 ; 53(1): 36-42. [CrossRef] [PubMed]
5. Tuli SM. Tuberculosis of the skeletal system: epidemiology and prevalence and clinical features. 2nd ed. New Delhi: Jaypee Brothers Medical Publication; 1997.
6. Tuli SM. Severe kyphotic deformity in tuberculosis of the spine. Int Orthop. 1995 ; 19(5): 327-31. [CrossRef] [PubMed]
7. Rajasekaran S. The problem of deformity in spinal tuberculosis. Clin Orthop Relat Res. 2002 ; (398): 85-92. [CrossRef] [PubMed]
8. Rajasekaran S. Buckling collapse of the spine in childhood spinal tuberculosis. Clin Orthop Relat Res. 2007 ; 460: 86-92. [CrossRef] [PubMed]
9. Rajasekaran S. The natural history of post-tubercular kyphosis in children. Radiological signs which predict late increase in deformity. J Bone Joint Surg Br. 2001 ; 83(7): 954-62. [CrossRef] [PubMed]
10. Alifano M, De Pascalis R, Sofia M, Faraone S, Del Pezzo M, Covelli I. Detection of IgG and IgA against the mycobacterial antigen A60 in patients with extrapulmonary tuberculosis. Thorax. 1998 ; 53(5): 377-80. [CrossRef] [PubMed]
11. Stroebel AB, Daniel TM, Lau JH, Leong JC, Richardson H. Serologic diagnosis of bone and joint tuberculosis by an enzyme-linked immunosorbent assay. J Infect Dis. 1982 ; 146(2): 280-3. [CrossRef] [PubMed]
12. John TJ. Interpretation of Mantoux test. Indian Pediatr. 1998 ; 35(6): 582-4. [PubMed]
13. Milosavljević T, Ivković A. Body spread of tuberculosis. Poster session presented at: Computerized tomography. 7th Balkan Congress of radiology; 2009 Nov 18-22; Istanbul, Turkey.

PRIMENA SAVREMENIH METODA U DIJAGNOSTICI VANPLUĆNE TUBERKULOZE

Tamara Milosavljević i Aleksandar Ivković

Po podacima SZO iz novembra 2011. godine, jedna trećina svetske populacije zaražena je bacilom tuberkuloze. Incidenca novih slučajeva u 2010. godini bila je 9.5 miliona sa prevalencom od 14 miliona slučajeva, najviše u regionu jugo-istočne Azije.

Cilj studije bio je da pokaže incidencu i karakteristike vanplućne tuberkuloze sa širenjem na urogenitalni i koštani sistem, kao i savremene radiološke procedure u dijagnostici vanplućne tuberkuloze.

Analizirano je 33 bolesnika sa urogenitalnom tuberkulozom i 77 sa koštanom. Kod svih bolesnika sa urogenitalnom TBC urađen je ultrazvučni pregled (UZ) i multislajsna kompjuterizovana tomografija (MSCT) a kod nekoliko i magnetna rezonaca (MR). Bolesnici sa plućnom tuberkulozom pregledani su na 16 slajsnom kompjuterizovanom tomografu (16 MSCT).

Znaci tuberkulozne infekcije nađeni su unilateralno u bubrezima, kod 97% slučajeva urogenitalne TBC i samo u jednom slučaju (3%) u oba. Kod dve bolesnice nađena je masivna infekcija bubrega, uretera, bešike i uterusa a kod jednog muškarca masivna infekcija bubrega, uretre, prostate i testisa. Od 77 bolesnika sa koštanom TBC, spinalna TBC je nađena kod 49 (62.22%) bolesnika, kod 3 (4.05%) u vilici, kod 2 (2.70%) u tibiji i kod ostalih u zglobovima (27.03%).

Vanplućna TBC može biti nađena kod bolesnika sa ili bez plućne TBC. Moderni radiološki prisupi su vitalni za ranu dijagnostiku. *Acta Medica Medianae 2012;51(1):5-11.*

***Ključne reči**: tuberkuloza, bubrezi, kosti, MSCT, MR*