

Management of spinal infections

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Abstract: Objective: The purpose of this study is to focus on recent means of diagnosis and recent lines of treatment of spinal infections as many modern modalities and surgical techniques emerged. **Methods:** From 1999 to 2004, thirty patients (23 males and 7 women) suffering from spinal infections had been surgically treated at El-Zharaa University Hospital, El-Helal Red Crescent Hospital, Ahmed Maher Teaching Hospital and Ibn Sina Specialized Hospital. The age of patients ranged from five to seventy six years. The infection was tuberculous spondylitis in 18 patients and pyogenic spondylitis in 12 patients. All vertebral levels were affected in this study. The most commonly affected spinal level was the lumbar spine in 13 cases. Then comes the dorsal spine in 7 cases, then dorso lumbar spine in 5 cases, then lumbosacral spine in 3 cases and lastly cervicodorsal spine in 2 cases. Pyogenic spondylitis had affected twelve patients with lumbar spine much more commonly affected (7 patients). The dorsal and dorso lumbar were equally affected 2 cases for each while the lumbo-sacral spine was affected in one patient. Tuberculous spondylitis affected lumbar spine in 6 patients, the dorsal spine in 5 patients the dorso lumbar spine in 3 patients and the cervicodorsal spine and lumbo-sacral 2 patients for each. **Results:** Success rate was recorded in twenty eight patients (93.4%). Failure rate was recorded in two patients (6.6%). **Conclusion:** Surgical spinal fusion after through debridement carries the best short term prognosis and the best available prospect far long term results.

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1. Introduction

Spinal infections are evaluated according to their location, the pathogen or pathogens involved, route of the infection, age of the patient, and immune status of the host. The location of the infection may involve the osseous vertebra, the intervertebral disc, the epidural space, or the surrounding soft tissues. The pathogens are usually either bacterial or fungal; however, the widespread use of broad-spectrum antibiotics and the increasing number of immunocompromised patients have led to infections with unusual organisms.

The presentation and efficacy of the various elements of the initial evaluation differ markedly for acute hematogenous infection, granulomatous spinal infection, pediatric hematogenous discitis, epidural abscess, and postoperative spinal infection.

The optimal management of patient with spinal infection requires understanding of the circumstances that resulted in the infection, the organism involved, and the degree of bony and neurologic compromise.

Early detection and medical treatment may obviate the need for surgical intervention. When surgical debridement is indicated; its prompt initiation appears to result in good clinical outcomes. In addition, maximizing the patient's nutritional status will improve the outcomes of both medical and surgical treatment (Tay and Deckey, 2002).

2. Patients and methods

Participants:-

From 1999 to 2004, thirty patients (23 males and 7 women) suffering from spinal infections had been surgically treated at El-Zharaa University Hospital, El-Helal Red Crescent Hospital, Ahmed Maher Teaching Hospital and Ibn Sina Specialized Hospital. The age of patients ranged from five to seventy six years.

The infection was tuberculous spondylitis in 18 patients and pyogenic spondylitis in 12 patients. All vertebral levels were affected in this study. The most commonly affected spinal level was the lumbar spine in 13 cases. Then comes the dorsal spine in 7 cases, then dorso lumbar spine in 5 cases, then lumbosacral spine in 3 cases and lastly cervicodorsal spine in 2 cases.

Pyogenic spondylitis had affected twelve patients with lumbar spine much more commonly affected (7 patients). The dorsal and dorso lumbar were equally affected 2 cases for each while the lumbo-sacral spine was affected in one patient. Tuberculous spondylitis affected lumbar spine in 6 patients, the dorsal spine in 5 patients the dorso lumbar spine in 3 patients and the cervicodorsal spine and lumbo-sacral 2 patients for each.

Provisional Diagnosis:

Follow-up was from six to thirty six months. In assessing our patients we followed a standard procedure for all patients starting from the history of the disease to the end of preoperative investigation,

Pre-operative assessment:

- a. Clinical evaluation.
- b. Radiological evaluation.
- c. Laboratory investigation.

A- Clinical evaluation:

To assess patients pre-operatively we have followed a certain scheme for taking the history and performing the clinical examination.

1. History taking:

Personal data of the patient includes his/her name, age, sex, occupation, marital status, and good analysis of his/her living condition and socio economic standard.

Pain was the most frequent presenting symptoms. It was found in sixteen patients. Neurological symptoms were present in eleven patients. Two patients presented with sinus discharge and one patient presented with huge abscesses.

History of hospitalization and treatment for the same disease with special regard to its effectiveness. Family history of any disease suggestive of chest or spinal infection.

Past history of disease and operations especially those related to spine or pelvic organs. Any history of diabetes, rheumatoid arthritis, immune-ocompromise state from medical illness drugs pharmacologic immunosuppressive or history of intravenous drug abuse.

2. Examination:

General examination with stress upon the attitude of the patient during activity and rest, general look of the patient, his weight and presence of lymph nodes etc.

Chest and heart examination for breath and normal or abnormal heart sounds and chest movements to detect chest problems that may affect the choice of the approach as lung abscess.

Abdominal examination for movements with respiration, liver and spleen for enlargement or palpable masses, rigidity, tenderness and swellings especially the psoas abscess by palpation on the inner aspect of the wing of the illum and bimanual palpation above and below the inguinal ligament for large psoas abscesses, Thomas's test was per performed to detect unseen abscess , the cross fluctuation test. Lastly P-R was done to exclude other masses or rectal polyps or prostatic lesion.

Examination of the spine:

A. Patient standing:

Examination in the standing position was devoted for inspection and palpation of the back with special regard to the following points:

Swellings:

Paravertebral swelling can be detected by palpation, as doughy mass. The overlying skin was usually thickened and dusky. The total number of patients having abscesses detected clinically was (11)

patients (6) tubercles and (5) pyogenic only two cases showed bilateral clinical abscesses (PSA) (psoas).

Scars and sinuses:

Multiple scars were found indicating the chronicity of their diseases. Sinus was present in patients suffering disease with his sinus in the left lion. The total number of patients showing clinically detectable abscesses and sinuses was (13) patients of the whole group.

Movements of the spine:

The movements can be examined well in patients with little or no neurological affection. In nearly all our patients movements were markedly restricted due to muscle spasm, pain and sense of insecurity especially in the cervical and lumbo-sacral spine. Patients with lumbo-sacral lesions could not flex their trunks at all.

Deformity:

These included the inspection and palpation of any visible deformity whatever mild to detect its site and severity two additional tests were done for all patient having sever kyphosis to detect bridging of the lesion which may be difficult to assess by x ray examination we have (11) patients with kyphotic deformity.

i. Springing test: by exerting manual pressure over the apex of the kyphas while the patient is prone to detect movement of the apex.

ii. Stethoscope test: by percussing the spinous process immediately above the apex and auscultating through the spinous process immediately below the kyphas apex a resonant note indicates bony bridging (Hodgson and Stock, 1994).

Gait:

This can also be examined in patients without or with minimal weakness (grade D). The gait of these patients showed three patterns:

iii. Spastic gait.

iv. Patients needing much support during walking due to lower motor neuron lesion.

v. Patients suffering from lumbosacral affection walked with their lags separated apart and exaggerated lumber lordosis.

B. Patient leaning forward and sitting:

This was done to detect either correction of the kyphotic deformity which was not evident in any of our cases or instability felt by the patients when the patient supported himself using his hands against thighs.

C. Patient supine:

Movement of the hip joint to exclude extra spinal causes of the patients complaint. Also, Thomas test was performed to detect psoas abscess.

Neurological examination:

To detect neurological examination of the upper and lower limbs that included muscle state, tone, motor power, sensations (superficial and deep) and reflexes.

There are twenty one patients (70%) with neurological affection.

Frankel *et al.* (1969), adapted to classify our patients. The details of this classification are as follows:

Grade A: Complete neurological deficit with no sensory, motor, bowel or bladder sparing distal to the spinal lesion.

Grade B: Sparing of some sensation but no motor function distal to the spinal lesion.

Grade C: Sparing of sensation and non-useful motor function distal to the spinal lesion.

Grade D: Sparing of sensation and useful motor function distal to the spinal lesion.

Grade E: Normal neurologically.

Among our patients affected there were three grades represented:

Grade D: 9 patients (No. 2, 8, 9, 13, 15, 17, 24, 29 & 30)

Grade C: 9 patients (No. 4, 5, 7, 11, 14, 16, 19, 27, & 28)

Grade A: Three patients (No. 3, 6 & 10).

There were no patients in grade B.

Table (8): Clinical signs.

	Abscess		Sinus	Kyphotic deformity	Neurological deficit
	T.B	Pyogenic			
No. of patients	6	5	2	11	21
Percentage (%)	20%	16.7%	6.7%	36.7%	70%

B- Radiological Evaluation

Imaging studies are crucial to localize the infection, assess the extent of involvement and determine the response of treatment:

1. Plain roentgenography:

All patients were submitted to routine plain roentgenography in an antero-posterior and lateral views of the whole spine. We can demonstrate progressive osteolysis and plate destructions, disc space narrowing and kyphosis.

a. Disc space

In all patients the disc space which affected was narrowed markedly or completely obliterated and collapsed.

b. Destruction

This was seen as lytic area within the affected vertebral bodies extending from the disc space to the body with collapse of a long part of the body height in 19 patients (63.3%). However, the plain radiography shows only the destruction when it affects big bone mass but minute destructions appears in MRI or CT scan.

c. Kyphosis

Localized kyphotic deformity was detected in 11 patients (36.7%). In nine patients it was mild deformity the other two cases had severe hyphosis this sever hyphosis appeared only in the dorsal or dorso lumbar spine, while mild kyphosis was present in the lumbar spine.

Plain x-ray also used to measure the angle of deformity and angle of kyphosis. The angle of deformity (D) which is measured by drawing two lines, one on the superior surface of the uppermost involved vertebra and the other on the inferior surface of the lowermost involved vertebra. The angle of kyphosis (G) is measured by drawing a line on the upper surface of the first normal vertebra above the lesion and one on

the lower surface of the first normal vertebra below the lesion.

Chest x-ray was done to all patients to exclude tuberculous lesions of lungs.

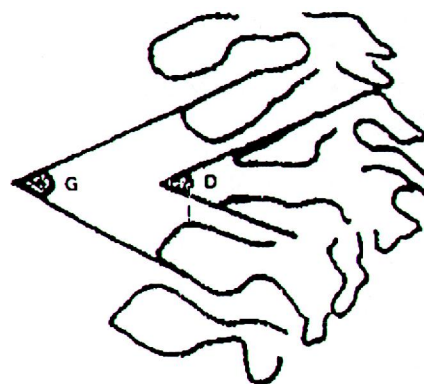


Fig. (1): Diagram showing the angle of deformity (D) which is measured by drawing two lines, one on the superior surface of the uppermost involved vertebra and the other on the inferior surface of the lowermost involved vertebra. The angle of kyphosis (G) is measured by drawing a line on the upper surface of the first normal vertebra above the lesion and one on the lower surface of the first normal vertebra below the lesion. (Rajasekaran, 2001)

2. Magnetic resonance imaging (MRI):

Is the modality of choice in the diagnosis and evaluation of spinal infections because it provides excellent imaging of the soft tissues, neural elements and inflammatory changes in the bone:

- MRI has an extremely high sensitivity (96%) and specificity (93%) in detecting infection of the vertebral columns. It's non invasive.

- T1-weighted sequences demonstrate decreased signal intensity in both the vertebral body and disc from edema.
- T2-weighted image show increased signal intensity in both the vertebral body and disc material.
- The administration of gadolinium in combination with MRI improves resolution and allows to differentiate infection from degenerative change of the end plate and intervertebral disc.
- The vascular-based enhancement allows differentiation of an epidural granulation from an epidural abscess.
- Short T1 inversion recovery sequences often can help to differentiate an infection from other pathologic entities even with MRI however Granulomatous infection can be difficult to be distinguished from tumours of the spine. Thus a biopsy is often required as a definitive diagnosis.

3. CT scanning

CT is useful in delineating the extend of bony destruction and soft tissue extension and is helpful in pre-operative planning.

4. Radionuclide studies

Radionuclide studies can be much more sensitive than radiographs in detection early infection. Technetium 99m bone scintigraphy is sensitive (90%) but non specific.

When used TC 99m scans with gallium 67 citrate scans have high sensitivity and specificity in detection foci of infection. This type of investigation is valuable in early state of spinal infection.

C- Laboratory investigations

I- Specific investigation:

These laboratory tests that can help in identification or determination of the activity or prognosis of the disease. These include:

1- Hematological tests:

Complete blood picture:

It was essential for determination of hemoglobin percentage (HB%) to determine the degree of anaemia if present and also for possibilities of blood transfusion before the operations to improve the general condition of the patient. These were a mild anemia in most patients. Only three patients showed levels below 10 grams. These patients needed blood transfusion before the operation.

Total and differential leukocyte counts: The range of total leucocytic count was between 6.300/C.Cs and 12.000/C.Cs, the differential count was nearly normal in all patients.

Erythrocytic sedimentation rate: It was elevated in all patients; however the elevation in chronic osteomyelitis was less than that of Pott's disease.

- In Patients of chronic osteomyelitis the range was 25 - 95mm/houre.

- In patients of Pott's disease the range was 25 - 120mm/hours.

2- Biopsy:

The definitive diagnosis of spinal infection requires identification of the organism through a positive blood culture or from a biopsy and culture of the biopsed material.

Blood culture: these were done primarily to detect pyogenic organism. Three blood samples were taken from every patient during the same day, one in morning second in afternoon and third one at the night. These cultures have grown staphylococcus auras in only two patients; had attacks of pyrexia during stay in hospital in the pre operative day.

Culture from sinus discharge was done after examination with gram ands ziel-nelson stain for proper antibiotic regimen.

Polymerase chain reaction (P.C.R) for rapid detection of infecting agent especially with low virulence organism are involved, technical problems with cross contamination can lead to false positive results.

II. Non-specific investigations:

These were done for general check up of the patient:

- 1- Urine and stool examination.
- 2- Liver and kidney functions.
- 3- Electro cardiogram.
- 4- Fasting and post prandial blood sugar.

Operative Findings

In discussing intra-operative pathology we can divide it into three major groups which are

- a) Changes in soft tissues
- b) Changes in vertebral bodies and discs
- c) Changes in the spinal canal

A- Changes in soft tissues:

The most constant finding was the abscess whatever its location either in paraspinal soft tissues, intaraosseous (IOA) , or in the psoas muscle (PSA). Abscesses were found in 11 patients (36.7%). The incidence of abscess in cases of Pott's disease was 6 Patients (20%). While abscesses in cases of pyogenic infection were found 5 patients (16.7%).

Psoas abscesses

In cases with abscess within the psoas muscle, the sheath of the muscle was found dull and thickened with dark brown patches of necrosis scattered allover the sheath.

The muscle fibres showed necrosis with dark brown or sometimes black patches. Also, with huge abscess the muscle belly was reduced in size to a few shreds of muscle fibres. This was best evident with the largest abscess found in the series.

Adhesions:

Adhesions were severe in most of cases necessitating the use of electrocautery to open the way

to vertebral bone without trial to isolate segmental vessels before their ligation. However, in no case the ureter was found adherent to the area of the lesion.

B- Changes in vertebral bones and discs

Destruction of vertebral bones was severe in all cases. Destruction of the discs was more than destruction of bone. Also, in most of cases removal of diseased bone and disc material was easily accomplished.

Bony sequestra within the affected vertebrae were found in only three patients. The sequestered bone was avascular and chalky in appearance.

Sclerosed bone was hard and dull to percussion. It was difficult to cut through this sclerosed bone, so, the use of sharp gouges and osteotomes was mandatory to open windows through this bone.

Cavities were present in almost all cases. In nearly all of these cavities pus or granulation tissue was found. The pus was either thick creamy or thin serous.

C- Intraspinal pathology:

This was found in eighteen patients (60%) Many pathological findings were present in the spinal canal. These are:

1- Localized Epidural (Intraspinal) Abscess:

This was found as a posterior bulge of the posterior longitudinal ligament which was thickened and inflamed. This bulge contained pus and granulation tissue. It was found in 10 patients.

2- Diffuse intraspinal abscess:

This was found as a sheet of granulation tissue surrounding the dural sac. It was found in two patients.

3- Bony ridges:

These were found as transverse elevations from the posterior aspect of the bodies at the level of maximum deformity. These were found only in two patients.

4- Soft tissue sequestra:

These were representing disc material squeezed into the canal and compressing the dural sac. However, in some cases their consistency was much softer than a disc. These were considered as detached shreds of granulation tissue and found in 7 patients.

5- Intraspinal bone fragments:

These were bony sequestra inside the spinal canal. These were found in three patients. The last case showed a large sequestrum about 0.5 X 1.6cms, so obliterating a large portion of the lumbar spinal canal and causing severe neurological deficit.

6- Meninges and cord:

Apart from compression imposed on them they revealed no pathological changes. The cord was much flattened in two patients. Also the dura was not pulsating, however, it regained pulsations once it was decompressed. In both patients there was a severe kyphos.

Final Diagnosis

The final diagnosis of our cases was based upon smears, cultures and histopathological examination of specimens removed during debridement.

A- Smears

Smears were stained with gram and Ziel Nelsen stain from fluid pus obtained during operation. This pus was obtained from the psoas, paraspinal or intraosseous abscesses found on curetting the vertebral bones and opening of cavitations present therein.

Gram stain showed the presence of *Staphylococcus aureus* in ten patient (33.4%), *Pseudomonas aeruginosa* in one patients (3.3%) and *Escherichia coli* in one patients (3.3%), Ziel Nelsen stain revealed tubercle bacilli in only four patients (13.3%) while in all other patients (46.7%) the direct smear for *Mycobacterium tuberculosis* was negative.

B- Cultures:

Cultures of the same specimens were done for pyogenic organisms and for *Mycobacterium tuberculosis*.

Cultures for pyogenic organisms gave the same results as the direct smear. Cultures for tuberculosis on Lowenstein-Jensen medium revealed the organisms in all cases of tuberculosis (18 cases).

Antibiotic sensitivity tests:

The culture material was subjected to antibiotic sensitivity test.

Generally, pyogenic organisms were sensitive to one of the cephalosporins.

In tuberculous cases, all specimens were sensitive to isoniazide, rifampicin, ethambutol and streptomycin. Five patients were resistant to thiocetazone.

C- Histopathological examination

Two separate specimens were taken from every case and preserved in normal saline and sent to the laboratory within two hours.

The first specimen was taken from soft tissues as psoas sheath, the wall of prevertebral abscess or disc material. The second specimen was taken from bony parts removed at operation.

Reversal of provisional diagnosis

This occurred in only three patients in two patients the professional diagnosis was preoperatively diagnosed as Pott's disease due to presence of severe toxemia and weight loss but their final diagnosis was proved to be a chronic osteomyelitis after biopsy.

The third patients showed much bony sclerosis with good general condition pre-operatively. He was considered a case of chronic osteomyelitis. But proved to be a case of Pott's disease after result of histopathology and cultures.

Post Operative Care

A- Post-operative immobilization

All patients were left to lie freely in bed without external immobilization. Except one case with cervico-

dorsal Affection was able to walk after three weeks after his recovery of neurological deficit. However, measures for a tailor brace were taken pre-operatively. The patients were permitted to turn in bed with the help of a nurse or attendant. They were also permitted to move their legs and do isometric contractions and chest exercises by the help of physiotherapist from the second post-operative day.

After removal of stitches between the tenth and fifteenth day; by which time the brace was ready; trials for setting, standing and walking were started while wearing the brace. The braces were of two types:

- The long back brace for dorsal and dorsolumbar cases above L₃. This brace contained a shoulder strap on each side and a hard leather abdominal pad. The lower limit of the brace was resting on the iliac crest.

- The lumbosacral brace which extended from the area of greater trochanters to the mid-dorsal spine.

All patients were instructed to walk after amelioration of their pain. The walking distance was judged only by patient fatigue and pain.

B- Wound care:

Wounds were inspected three times during the post-operative period. The first time on the second post-operative day to detect the formation of haematoma.

In one patient there was ooze from suture line and swelling indicating presence of haematoma which was aspirated using a (G-14) cannula.

The second time was on the seventh post-operative day to inspect the wound edges for oedema, tension or wound discharge. The same patient showed signs of haematoma again, however, this time the patient was transferred to the operating room and the wound was opened again, haematoma evacuated and this haematoma did not recur.

The third time was at removal of stitches with every time the wound was dressed using Antiseptic solution.

The sites of wound graft were inspected on second postoperative day and drain was removed, these stitches were removed and wound dressed at two weeks. For both wounds tincture benzoin was applied to the wound at the final dressing and the wound left exposed. All wounds healed by primary intention.

Treatment

Post-operative medication

1) Specific therapy:

All patients had taken pre-operative medications according to provisional diagnosis. So, cases with provisional diagnosis of chronic osteomyelitis received the following drugs

a- Kefzol: It was given to all patients of osteomyelitis Except two patients as they were

sensitive to it. It was given in a dose of one gram every eight hours parenteral for three weeks.

b- Amikin: It was given two patients in a dose of half gram by parenteral route every eight hours for three weeks. Monitoring of kidney function via a biweekly determination of serum creatinin level was done through the period of treatment.

In all cases of Pott's disease the pre-operative antituberculous regimen was continued post-operatively as follows:

a- Rifampicin

The dose of rifampicin was adjusted to be 5mg/kg/day in a single daily dose taken half an hour before breakfast. All adults have got a dose between 450 and 600mg daily according to their body weight. In children (Cases no. 3 and 6) the dose was 10mg/kg/day. So, patient (No. 3) received 150mg at the start of treatment. His dose was increased after two months to 300mg daily as he gained twelve kilograms within this period.

In case (No. 6) the starting dose was 300mg daily, also this was increased into 450mg after three months of therapy.

b- Isoniazid:

This drug was given in a dose of 5mg/kg/day for adults and 10mg/kg/day for children. It was given also in a single daily dose. All adults received from 250 to 300mg daily. Children (cases No. 3 and 6) received 100 and 200mg daily at the start of treatment. This dose was increased after gaining weight to 200 and 250mg respectively.

c- Ethambutol:

The dose of ethambutol was 25mg/kg/day at the start of treatment to be adjusted after two months into 15mg/kg/day. The range of initial dose was between 1200 and 1600mg daily, while the dose after two months ranged between 800 and 1200mg daily. This dose was divided into 3 to 4 equal daily doses. Children did not receive ethambutol.

d- Para-aminosalicylic acid. (P.A.S.):

This was given to children (Case no. 3 and 6) in a dose of 8-12 grams daily divided equally into three daily doses.

Regimen followed for all patients entailed administration of the three drugs continuously for nine months without interruption.

After nine months all drugs were discontinued and patients closely observed for any recurrence for the rest of follow up period.

2) Adjuvant therapy

The most two important items added to treatment were pyridoxine and multivitamines.

a- Pyridoxine:

This was given in a dose of 50mg daily for the whole period of treatment to prevent its deficiency due to isoniazid administration.

b- Multivitamins:

Especially those containing iron were given to all patients for periods ranging between three to six months.

Post Operative Assessment and Follow Up

All patients were assessed clinically and radiologically every month till the end of the first three months, then every three months thereafter till the end of follow up period. Also, during follow up visits, laboratory tests were done to verify the control of the disease and to discover any toxic reactions of drugs.

A- Clinical assessment:

A thorough clinical examination was done with special attention to the following items.

General condition and patient feeling of pain during rest and activity. Pain was rapidly relieved in most of patients within three months.

Patient weight: most of patients have gained weight within the first three months.

Neurological assessment:

Generally, improvement in neurological status was maximum within the first month. However, continuous slow improvement was observed throughout the first six months. Clonus was the last sign to disappear.

Sinuses and abscesses

Within the first three months all clinically detectable abscesses disappeared and all sinuses closed

Toxic manifestations:

Malaise, fever and loss of appetite were almost relieved within the first three months in all patients

Activity:

This was gradually resumed after the third month but full activity was postponed till radiological evidence of fusion.

B- Laboratory assessment

Complete blood picture was done for every patient to determine the degree of anaemia and changes

in leucocytic counts. The changes in blood picture were slow to develop.

The erythrocyte sedimentation rate returned to normal within six months.

Renal functions:

These were tested by serum creatinin level in patients taking amikin only within the periods of treatment biweekly and revealed no alterations.

Liver functions:

These were tested by determination of serum transaminases levels & serum bilirubin for all patients receiving antituberculous chemotherapy.

C- Radiological assessment:

Plain radiographs were taken weekly while the patient at hospital to check the position of the graft. Then every three months to inspect for fusion.

Also, radiographs were examined for resolution of abscess shadows. By the ninth month no radiological evidence of abscess were detected.

Length of Follow Up

The length of follow up ranged between at least six months to 24 months. However, for better assessment patients were classified into four groups.

The first group: (10%)

Those are patients followed for less than six months. Those were three patients.

Second group (16.66%):

Those are patients followed for a period ranging between 7 and 12 months. Those were five patients.

Third group (30%):

Those were nine patients who were followed for a period between 13 and 18 months.

Fourth group (43.33%):

Those were thirteen one patient who were followed for a period between 19 and 24 months.

So, twenty two patients (73.3%) were followed for more than one year.

Table (9): Length of follow up.

Group	Length of follow up	No. of patients	Percentage (%)
First	Less than 6 months	3	10 %
Second	7-12	5	16.6 %
Third	13-18	13	30 %
Fourth	More than 19 months	13	43.3 %

Final Assessment

Every patient was assessed at the final visit clinically and radiologically. Thirty patients have been subjected to this assessment.

I- Final Clinical Assessment

This entailed careful questioning of the patient about toxemic symptoms, pain and activity. Also careful examination of the patient for tenderness.

Abscesses, sinuses and spinal mobility in addition to meticulous neurological examination

A- Toxaemia:

Non of the patients showed symptoms or signs of toxemic manifestations as fever loss of appetite or weight. Indeed most of patients especially those who complained of appreciable weight loss pre-operatively gained weight post-operatively. This weight gain was

maximum within the first three months post-operatively.

B- Pain:

According to the same pre-operative pain grading was used which resulted in the following data: 27 patients (90%) had no pain on final assessment. Three patients (10%) had mild pain which was in most of cases occasional, infrequent or occurring only on severe exertion.

No patient complained of moderate or severe pain.

C- Activity:

Although all patients were instructed not to resume full activity before radiological evidence of fusion most of them feeling secure enough and having no pain returned to full working capacity between six and nine months post-operatively. However; for purpose of assessment; activity of patients on final visit or the visit that showed radiological fusion which of them earlier was considered. The activity of patients judged as normal, partial or no activity.

Normal activity:

For males this was considered when the patient could return to full working capacity without limitations & without change in their job nature.

For females who were all housewives it was considered when they could do all household activities without assistance, this entailed in one patient a recent marriage and three patients of childbirth (cases 8, 18, 25 & 26) out of 30 patients (86.6%) regained normal activity.

Partial activity:

Partial-activity was considered when a male has changed his job into a lighter one or obliged to decrease his working hours or avoided strenuous tasks within his job. For females it was considered when the lady needed assistance in a task she could do without assistance prior to the disease. Also patients needing a walking aid as a stick or crutch were considered of this group. These patients were three (10%).

No activity:

This was only one patient who was considered invalidated due to neurological complication (paraplegia). Although he regained sensations, he did not regain any motor function and on final assessment he was able only to move using a wheel chair (3%).

D- Tenderness:

Tenderness disappeared gradually and practically all patients followed for more than six months showed no tenderness at the area of spinal lesion.

E- Spinal movement:

Apart from the fused segment, all other spinal segments showed normal mobility. The overall range of functional spinal mobility was not affected by fusion.

F- Abscesses and sinuses:

No clinical abscess could be detected in any patients at the final follow up. As well, all sinuses closed within the first six months without recurrence. So, their rate of cure within follow up time was considered (100%).

G- Neurological status:

Meticulous neurological examination was done at last visit to determine improvement and residual disability. In the same way as pre-operative assessment **Frankel** classification was used to determine the extent of neurological deficit.

Out of the twenty one patients with neurological deficit pre-operatively, twenty showed neurological improvement (95.2%).

One patient remained stationary at grade D (case No. 8 i.e. 4.8%).

Out of thirty patients there are nine patients with normal neurological status pre-operatively. In more detail about the neurologically affected patients.

Group D:

It contained nine patients (No. 2, 8, 9, 13, 15, 17, 24, 29 and 30), eight of them improved to grade E, while one patient (No. 8) remained stationary.

Group C:

It contained nine patients (No. 4, 5, 7, 11, 14, 16, 19, 27, and 28). All of them regained full neurological status i.e. grade E.

Group A:

Three patient (No.3, 6, 10) who showed full recovery to grade E.

II- Final radiological assessment

Plain radiographs in antero-posterior and lateral views were taken for all patients. Bony fusion was considered when a continuous bone bridging of the area of lesion could be demonstrated. However, in some patients with severe kyphosis (cases No. 12, 13 & 14) radiographs of good quality could not be obtained, so, clinical assessment of fusion was done by the springing and stethoscope tests.

Patients in whom fusion was assessed were those followed for more than six months.

So, the total number of patients assessed for fusion is thirty patients. At the end of follow up two patients (6.6%) were not fused (patient's no. 6 and 23). While 28 patients have readied fusion (93.4%).

3. Results

The results of treatment for individual patients depend upon.

- Healing of the disease.
- Degree of pain.
- Return to activity.
- Neurological recovery.
- Reaching a state of bony fusion.

The results are divided into four groups.

A- Excellent:

- Absence of pain.
- Return to normal activity.
- Full neurological recovery.
- Bony fusion
- B- Good:**
- Presence of mild pain or
- Partial activity or
- Less than full neurological recovery or
- Favorable clinical status without bony fusion

C- Fair:

- Presence of mild or moderate pain plus
- Partial activity plus
- No neurological improvement plus
- Bony fusion

D- Poor:

- Presence of moderate to severe pain
- Partial activity or absence of activity
- Neurological deterioration
- Fusion or non-fusion

According to this grading the overall results are as follows:

Table(1): Results of treatment.

Results	No. of Patients	Percentage (%)
Excellent	twenty one patients	70%
Good	seven patients	22.4%
Fair	one patient No. 8	3.3%
Poor	one patient No. 7	3.3%

So, success rate was recorded in twenty eight patients (93.4%). Failure rate was recorded in two patients (6.6%).

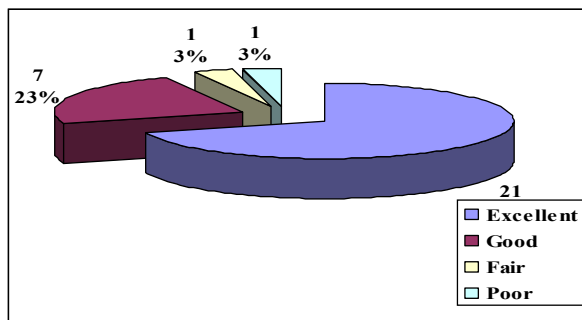


Fig.(2): Grading the overall results.

Complications

The complications encountered during this work were reported during the follow up. These complications are divided into minor and major types.

A- Minor complications:

1- Haematoma formation:

This occurred in one patient (No. 7). Once it was diagnosed by tension on suture line and oozing from the wound it was aspirated and if it collected again, open drainage was done through the operative incision.

Good hemostasis was done and hematoma dose not recur.

2- Minor surgical emphysema

This occurred in one patient (No. 9). It was not progressive and radiography of chest was normal and it resolved completely without treatment.

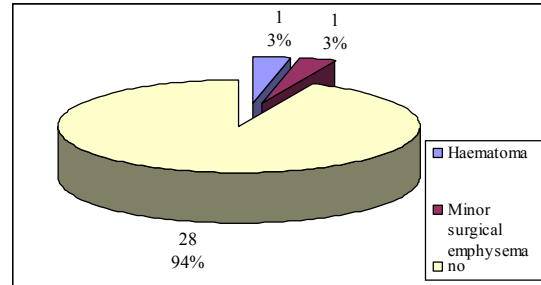


Fig.(3): Minor complications.

B- Major complications

1- Neurological complications

Two patients (6.6%) developed complete sensory and motor paralysis immediately after operation (patients No, 7 and 8).

In the first patient a haematoma was thought to be the reason. However, after evacuation of the haematoma there was no improvement. In the second case the graft was thought to be pressing on the cord as it appeared in post-operative plain radiographs, exploration was done but this compression could not be proved and the graft dose not removed.

Then both patients had been subjected to postoperative CT-scan with metrizamide which revealed no offending pathology in the first case, while in the second patient (No. 8) it showed a layer of granulation tissue posterior to the dural sac. This patient was subjected to dorsal laminectomy two weeks later. At operation a sheet of granulation tissue loosely attached to the dura was found with non pulsating dural sac. Laminectomy extended from D9 through D11. Gradual peeling of this layer of granulation tissue up and down until pulsations of dural sac was seen extending along the whole exposed area.

The first patient regained sensations completely within three months but never motor power. The second patient started to regain sensory and motor functions immediately after laminectomy and he showed progressive improvement till the sixth month and

he returned to the pre-operative neurological status and was able to walk with crutches. The removed granulation tissue was proved to be tuberculous in origin by histopathological examination.

2- Deep venous thrombosis:

This occurred in one patient (3.3%) in the third month postoperative. The clinical presentation was

tachycardia fever, rigors, calf pain and dyspnea. The patient was transferred immediately to I.C.U. and received subcutaneous heparin in a dose of 5000 I.U. every 6 hours. Within a few hours the patient started to get swelling of his left leg, thigh and left side of scrotum. Other medicine given to this patient included ampiclox injections, low molecular weight dextrans, and oxygen mask. Repeated radiographs of the chest and determination of prothrombin time and concentration to guide the dose of heparin. Prothrombin time was kept slightly more than double of the normal value and prothrombin concentration at 30 to 40% of normal. Also repeated leucocytic counts were done, they were elevated initially and started to subside as well as the fever, rigors and dyspnea disappeared. At this time warfarin was started and heparin gradually withdrawn along the next 48 hours.

Then the patient was shifted to the ward with leg elevation, crepe bandage, dandivan and antibiotics with biweekly determination of prothrombin time and concentration keeping them at the aforementioned values.

His last follow up was at six months and he was instructed to continue on half tablet of warfarin BP 1mg for another two months. By this time he could resume partial activity.

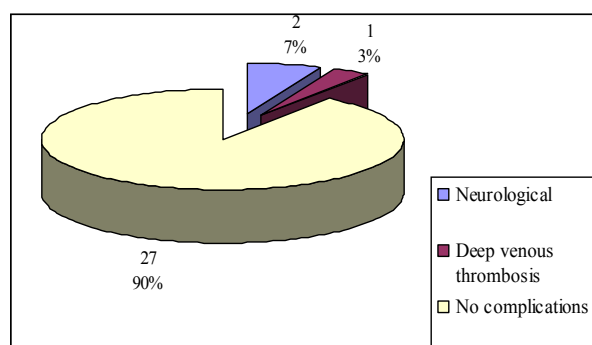


Fig.(4): Major complications

4. Discussion

In discussing the efficacy of various methods of treatment of spinal infections, it is too difficult to hold a true comparison: Firstly, because the criteria used for evaluation by many authors are not alike. Secondly, some of the results are not clearly depicted in most of original papers due to dropping of failures and deaths.

So, the available data will be discussed here individually with relation to the method of treatment. For better judgment the results of treatment of Pott's disease and pyogenic vertebral osteomyelitis will be discussed separately.

Results in Pott's disease

A- Conservative treatment:

Conservative treatment in pre-antibiotic days (orthodox) resulted in many failures especially in cases with paraplegia. The mortality rate was 30-50% and healing did not exceed 40%, while neurological recovery reported to lie between 40% and 60%.

Even those patients, who showed healing, often came later with reactivation which was frequently associated with neurological deficit.

Results of treatment after the introduction of antibiotics steadily improved year by year due to the introduction of more drugs and their excellent use in combinations. The mortality generally dropped to 10%, healing rate increased to 60-80%, recovery of neurological deficit between 60-80%. However, the rate of relapse of the disease was still high accounting for 5 - 10% and rate of bony fusion about 30-40% in most of studies with follow up for three years.

In recent years many authors reported even better results with conservative treatment alone as regards clinical healing and bony fusion.

Kemp et al. (1982) attained a rate of bone fusion in 56% with conservative treatment but rate of relapse was at 7%.

M.R.C.W.P., (1985) reported favourable response at three years of 84% and 88% in inpatients and outpatients respectively receiving standard chemotherapy of streptomycin, para-aminosalicylic and isoniazid. Bony fusion did not exceed 31%. Persistent abscess or sinus at the end of three years was noticed in about 8% of both groups.

Moon et al. (1997) reported favourable response in 95% of patients receiving chemotherapy alone, their rate of fusion was 36% at three years follow up.

B- Indirect surgical methods:

These included laminectomy, posterior spinal fusion and evacuation of abscesses. These were also done before and after the introduction of specific chemotherapy. In many reports about posterior fusions of Hibbs and Albee by (**Hibbs, 1918; Hibbs and Riser, 1928; Swift, 1940 and Hal lock, et al., 1954**) the rate of successful fusion with apparent clinical healing of the disease ranged between 64%-74.7%.

However, the rate of recurrence ranged between 11% and 35% and mortality rate was between 14.7% and 26.2% Neurological recovery was not assessed in most of these reports.

Lifeso, et al. (1985) reported neurological recovery in 55% of cases treated by laminectomy and in 79% of cases treated conservatively giving the clue once again that laminectomy is seldom of value in the treatment of paraplegia except in cases of laminar disease or diffuse intraspinal abscess.

C- Middle path and surgery less than radical

These two categories are included together because the middle path regime is essentially a conservative approach; however, surgery was done

when the conservative treatment failed. The surgical procedures assessed here include costotransversectomy with focal debridement and anterolateral rachotomy without grafting.

Konstam and Blesovsky (1962) using a method essentially similar to “middle path” attained clinical healing in 96%, recovery from paraplegia in 89%, deaths in 1.5% and relapse rate in 2%.

Risko, et al. (1963) combined costotransversectomy with posterior fusion and reported 82% clinical healing with recovery from paraplegia in 95%. The relapse rate was 7%, while death rate 1%.

Kirkaldy-Willis et al. (1965) using conservative therapy and surgery less than radical attained a rate of fusion of 85% and cure of paraplegia totally or partially in 94.2%. Their mortality rate was 3.4% without comment on relapses.

Langenskiold (1967) used debridement via anterolateral decompression and attained 74% cure of paraplegia.

Aim, (1968) attained full recovery of 70% and partial recovery of 11.9% in cases with neurological deficit using debridement only.

Wilkinson (1969) compared two groups of debridement with and without chemotherapy. The success rate was 95% and 80% respectively, and relapse rate 5% and 20% Deaths were equal at 2% for each group.

Tull, (1969); Tull and Kumar (1971) reported clinical healing in 95%, they claimed 80% recovery from neurological deficit. However, by careful analysis of **Tull, (1975)** report it was found that the conservative treatment yielded only 38% neurological recovery. The remaining patients underwent surgery, 69% of them fully recovered and 11% partially recovered. So, it is clearly obvious that surgical procedures yielded better results than conservative even in those cases where they are done as late procedures. The rate of firm bony fusion in their series was only 29.8% and rate of relapse 2% while deaths were 8%.

D- Radical surgery:

Hodgson et al. (1960) after doing his radical debridement and grafting attained clinical satisfactory results with fusion in 93% of patients. Neurological recovery was complete in 74% and partial in 17.1%. 1% relapse occurred while mortality rate was 4%.

Hodgson, et al. (1964) reported 100 consecutive cases of paraplegia treated radically. The rate of bony fusion was 84%. Paraplegia improved totally in 74% and partially in 10% an over all rate of 84%. There were 8 deaths. The fusion occurred in average time of 20 months.

Kohli, (1967) obtained recovery of paraplegia in 84.4%, fusion in 71%. His mortality rate was 4.2%. Overall satisfactory results were 97%.

Aim, (1968) obtained 87.7% recovery from paraplegia by radical operation.

Arct, (1968) treated old paraplegics (over 60 years of age) by radical operation reporting fusion in 90.3% within two years. The recovery from paraplegia was at a rate of 60% of total and partial recovery. He reported also that 57% of patients returned to normal activity within one year. **Kemp et al. (1973)** using different grafts obtained 71.6% fusion within 12 months, recovery from paraplegia in 96.9% with return to activity of most of his patients within 6 months; the relapse rate was 2.5% while mortality rate was 2.04%.

Lifeso et al. (1985) reported full recovery from paraplegia in 94% treated by radical operation.

In the most organized study between conservative, debridement and anterior fusion conducted by **M.R.C.W.P. (1973, 1978, 1982 & 1985)**, early results were in favour of the radical operation, while late results showed little difference between all groups except in persistent abscesses or sinuses which were more common with conservative treatment. This study also showed increase in kyphotic deformity with both conservative and debridement treatment, while radical group showed decrease in kyphotic deformity.

Table (11): Shows comparison of 10 years follow up between different methods of treatment of Pott's disease by M.R.C.W.P (1973, 1978, 1982 & 1985)

Treatment Item	Ambulatory	Debridment	Redical
Favourable status	88%	100%	98%
Fusion rate	85%	90%	97%
Vertebral loss	0.07	0.23	0.18 Vert.
Increase in kyphotic angle	7°	7.5°	1°
Replace	11.4%	--	2%
	Parapresis 3.5% abscess or sinus		(one case due to missed 2 nd spinal lesion)

As regards vertebral bone loss it was much less, even reversed (bone reconstitution) in the radical

group. These studies also clearly showed that rest in bed and plaster jackets are not more advantageous than

ambulatory treatment without support. Another finding was that treatment with isoniazid and para-aminosalicylic acid gave the same results as triple drug therapy when streptomycin was added in the first three months.

The favourable status was considered patients free of symptoms, regained their working capacity and without abscess or sinus and without neurological involvement.

In our series there were 18 patients of Pott's disease.

We followed the fusion rate was 97% which is comparable to best results reviewed through the literature.

The same number was followed for the overall result yielded 15 cases of success (favourable), a rate of 97%.

Thirteen patients with neurological involvement were followed, among them twelve recovered, with rate of 94.4%, comparable to the results in best hands during literature.

In our cases there were no relapses higher than other treated by radical operation.

Table (12) shows some of results of various methods of treatment employed throughout literature including our results for comparison.

Results in pyogenic vertebral osteomyelitis

A- Conservative methods

Garcia et al. (1960) reported satisfactory results in 75% of patients treated by plaster bed immobilization and antibiotics, then a brace/ collar or jacket for at least six months after discharge from the hospital. Death rate was 6.7%. They claimed that almost all cases healed by bony fusion within one or two years.

Griffiths et al. (1971) used the same technique. However, they resorted to evacuation of abscess in 18% of cases and they did posterior spinal fusion in 1% of cases.

They reported satisfactory results in 85.7%, persistent sinus in 3.6%, death rate of 10.7% all were related to infection.

B- Surgical treatment:

Kemp et al. (1982), treated cases of spinal osteomyelitis with radical surgery and reported 92.9% satisfactory result with bony fusion in 85.7%. The only failed case died 7.1%.

Eismont et al. (1992), treated patients without neurological complications conservatively with satisfactory results in 89%. Neurologically affected patients were treated surgically by either laminectomy or debridement using costotransversectomy without grafting. In cases treated by laminectomy 50% showed deterioration and 50% remained unchanged.

Kostuik, (1983) used radical treatment i.e. anterior decompression with simultaneous bone grafting to treat paraplegia due to vertebral osteomyelitis. He reported

100% full recovery with bone fusion. He used anterior internal fixation in two cases only.

Abramovitz et al. (1986) used laminectomy and costotransversectomy without grafting. Cases of laminectomy showed 57% satisfactory result. Cases with debridement showed the same figure/ however, with more fatalities.

In cases treated by debridement 50% were improved and 50% unchanged.

As regards cases of osteomyelitis in our series there were twelve cases of osteomyelitis. Favourable results were obtained in cases 90.9%. This figure is comparable with the results obtained by **Kemp, et al., (1982)**, but is superseded by **Kostuik (1983)**.

Eight of them have neurological deficit.

Bony fusion attained in six out of seven cases followed for fusion ; a rate of 85.7% ; the same rate attained by **Kemp et al. (1982)**.

So from the foregoing discussion it is clearly obvious that conservative treatment in cases of chronic osteomyelitis of the spine yields good results without operative risks and mortality.

However, in cases presenting with neurological deficits, the surgical methods give better results.

Among the surgical procedures, radical surgery with thorough decompression of the canal and fixation by instrumentation gives the best results.

Table (13) shows the end results of various methods in treatment of pyogenic vertebral osteomyelitis in comparison with our group of patients.

Summary and Conclusion

This research studying the management of spinal infection pyogenic and tuberculous through a complete radical surgical debridement and bone graft. From the patients iliac bone, ribs or fibular graft with posterior instrumentation of the spine by transpedicular screws.

Also, I discussed in detail the changes which happen on vertebral bone or soft tissues surround it with accurate explanation for changes which can be found in side spinal canal regarding for abscess or foreign body or sequestered disc and may be paraplegia as a result from above courses or as a result from sever kyphosis.

Regarding to methods of treatment this method was the radical surgical treatment by debridement of the spinal lesion and simultaneous grafting and posterior spinal fixations aiming for a bony fusion which is the only sure way of eradication of spinal lesion.

Different facilities available for diagnosis showed that the plain X-ray film and magnetic resonant imaging are quite sufficient to clearly depict the extent and nature of the lesion. This is especially true when aided by good laboratory investigation.

This work also showed that the surgical procedures are not unduly hazardous and that they can

be done efficiently in a moderately equipped centers, provided good surgical and nursing team is available.

The results obtained during method of treatment over other methods. In term of high percentage of bone fusion and recovered of neurological (95.2%) with high success rate (93.4%) and failure rate (6.6%) also the return of patients to normal activity was rapid and the hospital stay was at minimum compared with other

methods within our range of follow up there were no recurrences.

From the foregoing we can conclude. That surgical spinal fusion after through debridement carries the best short term prognosis and the best available prospect far long term results.

Also, it is a procedure that can be drew in many centers and medium sized hospitals scattered all over our country.

Table (13): Results of treatment in pyogenic vertebral O.M.

Author & Method	Favourable results %	Rate of fusion %	Recovery from paraplegia	Death	Failure	Remarks
Garcia (1960) conservation	75	Almost all	--	7.6%		
Griffiths (1971) conservation	85.7	Not recorded	--	10.7%	3.6%	Fusion not reported evacuation of absences of 7% fusion
Eismont (1992)						Neurologically free Pts.
Cons.	89	Not recorded		11		
Lam Deb.	0		0	-	50%	
n. affect	50		50		-	
Abramovitz (1986)						
Lam:						
Costo.	57	Not recorded	57		--	
Trans.	57		57	More		
Kostuik (1993)						
Radical for parapl.	100	100	100	0	0	2 cases were internally fixed
Kemp (1982) Radical surgery	92.9	85.7	--	7.1%		Cases without paraplegia
Present series 8/12 paraplegics	90.9	85.7	100	0	9.09%	

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