

Surgical Treatment of Nonspecific Spinal Infections

Essay

*Submitted for partial fulfillment of the master degree of in
Orthopedic Surgery*

By

Mahmoud Ibrahim Morshed Ibrahim

(M. B., B.Ch)

Ain-Shams University

Supervised by

Prof. Dr. Mohamed Ahmed Maziad

Professor of Orthopedic Surgery

Faculty of Medicine

Ain-Shams University

Dr. Ahmed Mohamed Morsi

Lecturer of Orthopedic Surgery

Faculty of Medicine

Ain-Shams University

**Faculty of Medicine
Ain Shams University**

2013

A decorative frame with a central yellow oval and green borders, adorned with intricate floral and geometric patterns in green, pink, and orange.

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا
عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

سورة البقرة آية (٣٢)



*First of all, all gratitude is due to **God** almighty for blessing this work, until it has reached its end, as a part of his generous help, throughout my life.*

*I would like to express my appreciation to **Prof. Dr. Mohamed Ahmed Maziad** professor of orthopedic surgery, faculty of medicine, Ain Shams university, for his kind and gentle guidance.*

*I would like to express my appreciation to **Dr. Ahmed Mohamed Morsi** lecturer of orthopedic surgery, faculty of medicine, Ain Shams university, for his close scrutiny, ideas and valuable discussions throughout the process of writing the essay.*

Last but not least, I dedicate this work to my family, whom without their sincere emotional support, pushing me forward this work would not have ever been completed.



Mahmoud Ibrahim Morshed Ibrahim

Contents

List of Abbreviations	i
List of Tables	iii
List of Figures	iv
Introduction and Aim of the Work.....	1
Anatomy of The Vertebral Column	4
Pathogenesis Diagnosis	35
Conservative Treatment	63
Surgical Treatment.....	72
Summary and Conclusion	117
References	120
Arabic Summary.....	--

List of Abbreviations

Abx	: Antibiotics
ALL	: Anterior longitudinal ligaments
ARM	: Arteria radicularis magna
ASA	: Anterior spinal artery
BMA	: Bone Marrow Aspirate
BMPs	: Bone Morphogenic Proteins
CBC	: Complete blood count;
CrCl	: Creatinine clearance
CRP	: C-reactive protein
CT	: Computed tomography
Cx	: Cultures
DRG	: Dorsal root ganglia
DVT	: Deep Venous Thrombosis
ESR	: Erythrocyte sedimentation rate
F-18 FDG PET	: Positron emission tomography with fluorine-18 fluorodeoxyglucose
FDG	: Fluoro-2- deoxy-D- glucose
FSU	: Fixed spinal unit
GRC	: Gray rami communicants
HIV	: Human immunodeficiency virus
IAR	: Instantaneous axis of rotation
MRI	: Magnetic resonance imaging
MSU	: Multilevel spinal
NZ	: Neutral zone
PCA	: Morphine patient-controlled analgesia
PET SCAN	: Positron emission tomography
PLL	: Posterior longitudinal ligaments
PPD	: Purified protein derivative
PRS	: Penicillinase-resistant synthetic
PVA	: Paravertebral abscess
SEA	: Spinal epidural abscess

List of Abbreviations (Cont.)

SI	:	Spinal infections
SPECT	:	Single photon emission computed tomography
SUV	:	Standard uptake value
SVN	:	The sinuvertebral nerves
TB	:	Tuberculosis
TED hose	:	Thrombo-embolic deterrant hose
TMP-SMX	:	Trimethoprim-sulfamethoxazole.

List of Tables

<i>Table</i>	<i>Title</i>	<i>Page</i>
1	Spinal infections and their location	43
2	Suspected pathogens according to predisposing conditions	50
3	Neuroimaging findings in patients with spinal infection with different imaging modalities	51
4	MR imaging findings of tuberculous spondylitis and pyogenic spondylitis.	57
5	Overview of sensitivity and specificity	60
6	Differentiating clinical, laboratory and imaging findings in spinal infections resulting from bacterial, tuberculous or brucellar infections	61
7	Suggested duration of antibiotic treatment in spinal infections	67
8	Suggested antimicrobial therapy for organisms in spinal infections	70
9	Showing some instrumentations used historically in spinal fusion	79
10	Comparison between different approaches in regard to the complications	93
11	Properties of types of autologous bone graft	105
12	Bioactive strategies	112

List of Figures

<i>Fig.</i>	<i>Title</i>	<i>Page</i>
1	Diagram showing the various forms of vertebral column morphology	7
2	Schematic representation of the main structural features of an intervertebral disc	8
3	Ligaments of vertebral Column	9
4	Median sagittal section through the lumbar region of the vertebral column	10
5	Arterial supply spinal cord	13
6	Internal vertebral venous plexuses	14
7	Transverse view of the lumbar intervertebral disc showing nerve supply	17
8	Diagrams show nerve root in relation to foraminal canal	19
9	Instantaneous axis of rotation of C1 under axial torsion	22
10	Instantaneous axes of rotation for the thoracic vertebrae	22
11	Instantaneous axes of rotation for the middle and lower cervical vertebrae	23
12	Instantaneous axes of rotation for the lumbar vertebrae	23
13	A spinal pathology can shift and enlarge the region in which the instantaneous axes of rotation are located	24
14	The mobile segment	25
15	Forces and movements of the mobile segment in three-dimensional space	27
16	The four primary forces along the spinal column	28
17	Diagnostic algorithm for spinal infections	46

List of Figures (Cont.)

<i>Fig.</i>	<i>Title</i>	<i>Page</i>
18	Algorithm for the intraoperative removal of tissue samples	49
19	Tuberculous spondylitis MRI A,B,C,D,E	55
20	Pyogenic spondylitis MRI A,B,C,D,E	56
21	Fluorine-18 fluorodeoxyglucose PET (FDG PET)	60
22	Antimicrobial treatment in pyogenic spontaneous spondylodiscitis	69
23	Harrington distraction rod and compression rod	80
24	Luque Segmental Spinal Instrumentation	80
25	Steffee vsp plate	81
26	Comparison between conservative surgery and instrumentation surgery in regard to complications	83
27	A 54-year-old man treated with corpectomy at C5 and C6, strut grafting and anterior instrumentation	84
28	Diagram showing different implants used in spinal fusion	89
29	A metal cage filled with bone graft is placed between lumbar vertebrae	90
30	Comparison between different approaches in regard to complications	94
31	Cervical non-specific spondylodiscitis in cervical vertebral bodies 3/4 and postoperative native radiological follow-up with properly positioned bone span and plate	102

List of Figures (Cont.)

<i>Fig.</i>	<i>Title</i>	<i>Page</i>
32	Three month postoperative native radiological follow-up after bilateral dorsoventral spondylodesis of thoracic vertebral bodies 2 and 3	102
33	The use of a rigid implant, whether a spacer or a cantilever fixation device, in conjunction with autograft or an osteoconductive bone substitute	111

Introduction

Spinal infections (SI) is a broad entity encompass a spectrum of distinct disease entities such as septic discitis, vertebral osteomyelitis, and epidural abscess, and are caused by a wide variety of organisms. Vertebral osteomyelitis represents approximately 2-7% of all cases of osteomyelitis⁽¹⁾.

Spinal infections is classified to specific and nonspecific (pyogenic), specific SI caused by TB, brucella, Syphilis and other infections - which is not our concern in this essay- while the nonspecific SI caused by many bacterial pathogens. Staphylococcus aureus remains the most common bacterial agent of pyogenic infections. In addition to TB, the HIV pandemic has caused a rise in cases due to nontuberculous mycobacteria and fungi⁽²⁾.

In recent years, a rise in the incidence of pyogenic and nonpyogenic SI has been reported as a consequence of an increasing number of individuals with predisposing factors such as advanced age, diabetes mellitus, chronic renal or liver disease, intravenous drug use, HIV infection, long-term steroid use, malignancy, chemotherapy, severe trauma⁽³⁾.

Diagnosis of Spinal infections is based on clinical, laboratory investigations and imaging. Suspected infections considered-in absence of microbiological or histopathological confirmation-when suggestive clinical features, appropriate MRI changes and elevated inflammatory markers were found and a positive clinical response to antimicrobial therapy was obtained⁽⁴⁾.

The principles of conservative treatment are to establish an accurate microbiological diagnosis, treat with appropriate antibiotics, immobilize the spine, and closely monitor for spinal instability and neurological deterioration⁽⁵⁾.

Some patients present late with failure of conservative treatment due to bacterial resistance to antibiotics, neurological complications or unfavourable general condition for chemotherapy and on them we turn to surgical management⁽⁶⁾.

The purpose of surgical treatment is to obtain multiple intraoperative cultures of bone and soft tissue, perform a thorough debridement of infected tissue and decompression of neural structures, and reconstruct the unstable spinal column with bone graft with or without concomitant instrumentation⁽⁷⁾.

Aim of the Essay

This study aims to stress on:

1. The importance of early diagnosis of spinal infections,
2. Early surgical intervention when indicated,
3. The recent trends in surgical management ,
4. The overall role of surgery, and
5. The appropriate duration of antimicrobial treatment .

Anatomy of The Vertebral Column

General Characteristics:

The vertebral column usually consists of 33 vertebrae: 7 cervical, 12 thoracic, and 5 lumbar followed by the sacrum (5 fused sacral vertebrae) and the coccyx (4 frequently fused coccygeal vertebrae).

The cervical spine consists of the first 7 vertebrae in the spinal column. Typically these vertebrae are small and possess a foramen on the transverse process for the vertebral artery. The thoracic spine consists of the next 12 vertebrae and is stabilized by the attached rib cage and intercostal musculature. The lumbar spine consists of a mobile segment of 5 vertebrae, located between the relatively immobile segments of the thoracic and sacral segments. The lumbar vertebrae are particularly large and heavy in comparison with the cervical and thoracic vertebrae. The bodies are wider and have shorter and heavier pedicles, and the transverse processes project somewhat more laterally and ventrally than the other spinal segments. The laminae are shorter vertically than the bodies and are bridged by strong ligaments. The spinal processes are broader and stronger than those in the thoracic and cervical spine.

The primary curvatures are located in the thoracic and sacral regions and the secondary curvatures are located in the cervical and lumbar regions.

Consist of

- 1- **Bones:** (body, vertebral arch, vertebral arch, vertebral processes, costal facets, foramina).
- 2- **Soft tissues:** (disk, ligaments, muscles, blood supply).
- 3- **Neural elements:** (Spinal cord and Associated Structures) .

Bones

Typical vertebra: (Fig.1)

Consists of a body and a vertebral arch with several processes for muscular and articular attachments.

Body:

Is a short cylinder, and is separated and also bound together by the intervertebral disks.

Has costal facets on its side, which articulate with the heads of the corresponding and subjacent ribs.

The vertebral arch:

Consists of a pair of pedicles laterally and a pair of laminae posteriorly.

Gives rise to seven processes: four articular, two transverse, and one spinous.

Vertebral processes:

The spinous process

Projects posteriorly from the vertebral arch.

The transverse processes

Project on each side from the junctions of the pedicles and laminae and articulate with the tubercles of ribs 1 to 10 in the thoracic region.

Articular processes (facets)

These are two superior and two inferior projections from the junction of the pedicles and laminae.