Epitomes

Important Advances in Clinical Medicine

Orthopedics

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The Council on Scientific Affairs of the California Medical Association presents the following epitomes of progress in orthopedics. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and clinical importance. The items are presented in simple epitome, and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist busy practitioners, students, researchers, and scholars to stay abreast of progress in medicine, whether in their own field of special interest or another.

The epitomes included here were selected by the Advisory Panel to the Section on Orthopedics of the California Medical Association, and the summaries were prepared under the direction of David B. Thordarson, MD, and the panel.

Orthopedic Implications of Tuberculosis

TUBERCULOSIS IS undergoing a resurgence in the United States, associated with the acquired immunodeficiency syndrome (AIDS) epidemic, the influx of immigrants from underdeveloped parts of the world, and perhaps some increased complacency in the medical community. About 15% of cases of infection with *Mycobacterium tuberculosis* are extrapulmonary, and of these, 9% to 10% involve the bones and joints. In the vast majority of cases, the organism is delivered to the skeletal system during lymphohematogenous dissemination from a pulmonary focus. The organism may lie dormant in the skeletal system for long periods after the initial dissemination before disease is detected and typically progresses from a focus in the epiphyseal region of the bone, where it may produce either chronic arthritis or osteomyelitis.

Tuberculous arthritis typically occurs as chronic monarthric (monoarticular) arthritis. The infection is slowly progressive. The knees, hips, ankles, and wrists are most often involved. Pain and swelling are common features of this form of arthritis, and years may pass before a diagnosis is established. Biopsy of the synovium will typically yield granulomas. Aspiration with the appropriate stain and culture is always necessary, but the initiation of treatment often requires a high index of suspicion, a positive tuberculin skin test, and sometimes a characteristic appearance on synovial biopsy. A positive smear culture is always a reassuring confirmation of the diagnosis.

Therapy now relies on the use of a four-drug combination for sensitive stains of *M tuberculosis*, at least for the first two months, followed by prolonged treatment with isoniazid and rifampin. Treatment durations of at least a year seem appropriate. Surgical debridement is unnecessary in all but advanced cases; results are excellent if the disease has not progressed. Advanced degrees of joint destruction before therapy is started lead to a poor prognosis.

Tuberculous osteomyelitis most commonly involves the spine (vertebral osteomyelitis or Pott's disease). The disease typically involves the intervertebral disc, leading to destruction of the disc and anterior wedging. The thoracic spine is most commonly involved, followed by the lumbar area. Pus may form and dissect into the neck, groin, buttocks, or other areas, and large paraspinous abscesses may occur. Characteristic roentgenographic changes can be seen with destruction of the disc space and bony erosion. Neurologic impairment and damage may occur if caseous or granulomatous material impinges on the cord.

The diagnosis is established through a bone biopsy and culture, either with a needle or with open surgical intervention. Treatment is again largely medical, although surgical treatment may be required to relieve pressure on the cord in patients with neurologic impairment or to stabilize bone. In general, paraspinous abscesses do not require drainage if they are tuberculous in origin and not associated with signs of neurologic compromise. Treatment should be extended for as long as two years. The results of therapy should be excellent if the disease is diagnosed early.

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Bone Graft Substitutes

BONE GRAFTING is commonly used to augment bone repair, with several approaches to reconstructing or replacing musculoskeletal defects. The autogenous grafts can be cancellous, nonvascularized cortical, or vascularized cortical. Because these grafts are associated with

several shortcomings, however, including an 8% incidence of substantial morbidity, alternatives to autogenous bone grafting have been developed. Grafting substitutes currently include cancellous and cortical allografts, ceramics, demineralized bone matrix, bone marrow, and composite grafts.

The bone grafting process uses three elements: osteogenesis, osteoinduction, and osteoconduction. Osteogenic cells have the potential to differentiate and facilitate the various stages of bone regeneration. Osteoconduction provides a matrix that is a nonviable scaffolding, conducive to bony ingrowth. Osteoinduction includes chemical or physical agents that induce the various stages of bone regeneration. Each of the graft substitutes has one or more of these components.

Allografts can provide structure and an osteoconductive environment. They provide local growth factors and osteogenic cells. Structural allografts induce a modified rejection response from the host that varies from massive dissolution of the graft to benign neglect. These grafts have a substantial rate of nonunion (>10%), fracture (>10%), and infection (15% to 20%). In addition, the grafts can carry hepatitis and the human immunodeficiency virus (HIV; 1 per 1 million cases).

Ceramics are grouped into hydroxyapatite and tricalcium phosphate. Hydroxyapatite is similar to the human bone mineral phase, with the exception that the ceramic does not include the many imperfections of human bone. It is turned over slowly (>10 years). Tricalcium phosphate is converted in the body in part to hydroxyapatite. It is more easily resorbed, but large segments of this ceramic still last beyond five years. Synthesized ceramics are brittle, lack direct porous connectivity, need bony ingrowth to improve their mechanical properties, and require either osteogenic cells or growth factors to succeed. A new form of ceramic synthesized from coral has the three-dimensional microstructure of bone. These coralline ceramics are commercially available with average pore sizes of 500 and 200 μm.

Demineralized bone matrix removes the mineral phase and exposes the underlying bone collagen and growth factors, most notably bone morphogenetic protein. These grafts have no structural capability but provide sufficient bone morphogenetic protein to osteoinduce bone in osseous defects.

Bone marrow has a substantial number of osteogenic cells that are capable of providing bony regeneration. It has been demonstrated that 150 cm^3 of bone marrow can successfully heal established tibial nonunions. Most researchers in the field of bone grafting urge the coinsertion of bone marrow with any of the bone graft alternatives.

Composite grafts combine hydroxyapatite and tricalcium phosphate with bone marrow to heal bone defects. In a randomized controlled study, Collagraft performed as well as autogenous bone graft in repairing long-bone fractures. When the grafting site is compromised, a composite of particulate ceramic, bone marrow, and demineralized bone matrix that incorporates all the regenerative elements may be just as effective as autogenous cancellous bone graft.

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Arthroscopic Subacromial Decompression for the Shoulder Impingement Syndrome

A PAINFUL SHOULDER IMPINGEMENT syndrome has become a more meaningful problem in industrialized society because many occupations now necessitate prolonged periods of overhead activity. In this position, the shoulder is vulnerable to injury, especially the superior glenohumeral and inferior acromial structures. Repetitive damage can lead to the progression of the disease and eventual permanent shoulder disability. Most patients, however, respond to a simple treatment program aimed at modifying their activity, reducing inflammation, and strengthening the shoulder muscles.

The impingement syndrome of the shoulder compromises the space between the coracoacromial arch and the humeral head, resulting in soft tissue injury. The anatomic structures of the coracoacromial arch make up a roof over the humerus and include the coracoid, the coracoacromial ligament, the acromioclavicular joint, and the acromion. The subacromial bursa, the supraspinatus tendon, and the tendon of the long head of the biceps brachii are most commonly injured by the impingement syndrome. Forward flexion and internal rotation of the humerus bring these structures under the coracoacromial arch. This is especially true when the space is further compromised by anterior acromial osteophytes. It is also possible that persons with an acromial undersurface that is downward curved or hooked may be predisposed to the impingement syndrome.

Patients with the impingement syndrome initially have pain when they reach upward. Often there is also pain with motion behind the back, as occurs when reaching into the back pocket of pants. Athletes have specific complaints, and throwing a baseball provides a good model for all overhead throwing sports. Pitchers complain of pain in the anterior shoulder during the acceleration phase or sometimes the follow-through. Initially the pain subsides after a short rest, but pain may become relentless if the offending activity is not stopped. The pain is especially intense with forward flexion and internal rotation. Physical examination reveals tenderness with palpation of the anterior acromion, and the Neer impingement maneuver reveals pain during passive forward flexion of the shoulder. Irritation of the rotator cuff may be reproduced by pain and weakness with specific strength testing. It is especially helpful to infuse 10 ml of lidocaine into the subacromial bursa and then to repeat the Neer impingement test. If the impingement syndrome is the sole problem, there should be a 70% to 100% diminution of the pain and normal rotator cuff strength.