Arthritis, Ancient and Modern: Guidelines for Field Workers

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Symposium Summary
As anticipated, the symposium was a valuable learning experience and provided an opportunity for specialists in apparently unrelated disciplines to exchange varied viewpoints in both medicine and anthropology.

It became apparent as the symposium progressed that the following areas were ones of mutual agreement.

1. Causes of the major types of arthritis remain unknown.

At present, we can describe the gross features, detailed morphology as viewed by electron microscopy, and complicated biochemical changes of different types of arthritis, but in general we do not understand the etiology of most of these disease states. Important questions remain unanswered: What agent(s) is responsible for causing rheumatoid arthritis? What is the life cycle of an osteophyte? What overall factors are responsible for the development of osteoarthritis? What conditions favor the spondylitic process?

2. Some factors are known.

Septic arthritis can frequently be documented and related either to a generalized infectious process such as gonorrhea and dysentery or to a traumatic wound that perforates the joint cavity. Metabolic alterations such as hyperuricemia, the hallmark of gout, can be linked to attacks of acute arthritis. It is also quite clear that overuse of a joint can lead to changes of a traumatic and subsequently degenerative nature. Aging is also a potent factor, as the incidence of pathologic changes rises sharply with advancing years.

3. Disability from arthritis.

It is common for persons studying ancient bones with apparent arthritic changes to conclude that the population under scrutiny must have been so disabled as to be severely handicapped in its struggle to survive. This is not necessarily the case, as today practicing physicians often see patients who have marked changes in their joints yet suffer no pain and carry on their lives without any major difficulty.

4. Arthritis was more common in antiquity than it is today.

Angel has argued earlier that arthritis in ancient times was considerably more common than it is today, and he stated further that its incidence has declined steadily through classic times to the modern period. His new data from Turkey and Byzantium, presented at this symposium, do not confirm his earlier hypothesis. However, various reports showed a good deal of evidence to indicate that formerly almost everyone in late adult life had joint pathology, just as it is prevalent today in our senior citizens. Because life expectancy thousands of years ago was much shorter than it is today, “arthritis” must have struck in earlier decades of life. If life expectancy today were 40 years of age, as it was in antiquity, instead of 70 years, few people in the 20th century would have any of the recognized major forms of arthritis.

5. Stress, arthritis and occupations.

It seems clear that a joint moved repeatedly, excessively, and under strain is more liable to develop some form of tissue reaction. The pathology so produced in a joint may be useful to indicate the individual’s way of life. The interpretation of the lesion can sometimes be checked for accuracy by comparison studies with peoples living in similar circumstances today.

In pre-agricultural times, people lived by hunting, fishing and the gathering of plants, seeds, nuts, etc. The actual techniques differed from place to place and climate to climate. Substantial knowledge has been gained by com-
parative studies of cultures such as those of the Indians of Brazil and North America, Eskimo, Kalahari bushmen, Australian aborigines, !Kung of East Africa, and so on. Allowing for variations, the aphorism "men hunt, women gather" seems to have some validity.

Hunting does not seem to be the type of occupation likely to be a major producer of arthritis (apart from the risks of accidents when tackling an animal like a mammoth with primitive weapons). An archer does not spend all day shooting arrows! However, the violent throw of a spear with a spear-thrower (atlatl in the Americas) could easily lead to a pathologic alteration in the joints of the throwing arm.

Food gathering is much more laborious. It is not just a simple task such as gathering berries from a bush. It can involve lengthy and tiresome efforts such as digging up deeply buried roots and bulbs with implements no more efficient than a pointed stick. Martin, Armelagos and King (pp. 60-63) have produced data to show that young women developed arthritis in certain joints of their arms beginning at an early age, but boys who did not go hunting until two or three years later demonstrated less arthritis at a later age.

There are certain imponderables in these studies. First, we do not know how many of the skeletons came from people who were left-handed instead of right-handed. Secondly, the people of ancient times presumably occupied the territories most favorable to their needs. By contrast, modern hunter-gatherers used in comparison studies have been pushed from the best locations by agricultural invaders and now, of necessity, eke a living out of marginal lands abandoned by their opponents. The Kalahari bushmen in ancient times, for example, would not live by choice in the desert but in more desirable territories. Yet even today a hunter usually needs only a few hours to obtain adequate food. In antiquity, the effort required during normal circumstances would have been minimal and therefore not productive of much stress-related arthritis.

With the development of agriculture, tasks changed and some became intensified. Turning over the soil with primitive wooden sticks or hoeing with stone adzes are jobs aptly labeled “back-breaking.” The constant strain on the arms and spine day after day, as well as the stooping needed for harvesting with a sickle, must have placed unremitting stress on overworked joints. It is not surprising that arthritic changes of certain areas of the skeleton are prevalent in adults from farming cultures.

6. Some forms of arthritis cannot be diagnosed in ancient skeletons.

The number of ways in which a joint can react to an insult are limited, so that pathologic changes overlap in different forms of arthritis, and it can be quite difficult to distinguish one kind of initial insult from another. It is indeed possible that the condition called “osteoarthritis” is a kind of general joint reaction to a number of noxious factors. If diagnosis in the living can tax the experience of the physician, it is vastly more difficult when the only specimen available for study is an ancient bone that has been subjected to centuries or millennia of leaching by water.

Cassidy tackled this problem in her paper (pp. 68-69) and attempted to list those diseases that could or could not be identified from bones alone. Her praiseworthy effort will be expanded in the following pages, as the various forms of arthritis are reviewed individually from the standpoint of the rheumatologist.

**Osteoarthritis and Osteophytosis**

It is quite clear that these two entities occur both separately and together. While osteoarthritis, the clinical syndrome, may be accompanied by numerous osteophytes as the disease progresses, the converse does not always apply, namely, that a large number of osteophytes represents severe disease.

The most characteristic paleopathological feature of osteoarthritis (degenerative joint disease) is eburnation, the evidence of direct bone-to-bone contact at the articular surfaces. Because the essential clinical feature of osteoarthritis in its earlier stages is the loss of articular cartilage, the amount of bone that is ultimately exposed and comes in contact with bone on its counterpart of the joint varies considerably. Generally speaking, the greater the area of contact, the greater the degree of disability. In these circumstances, the bones are usually of normal weight and normal thickness, although trabeculae immediately below the articular surface may be slightly thickened or sclerotic.

They are not usually osteopenic. Some areas on the articular surface may show “pitting” or “peppering” from minute cortical perforations, which probably occurs as the advancing edge of calcifying cartilage replaces the normal cartilage from below. These reactions usually occur in a joint that has developed excessive mobility within its capsule by loss of cartilage or laxity of ligaments and promotes an attempt to remodel the bone so that it will fit more exactly, thereby avoiding the strains due to abnormal movements. In general, these reactions are seen in nonweight bearing areas of the joint, such as the inferior aspect of the femoral head.

It is important to note that clinically there may be a marked discrepancy between the amount of joint space narrowing (on the radiograph) and the number and size of osteophytes as well as the degree of disability suffered by the afflicted individual. In Forestier’s ankylosing hyperostosis of the
spine, there is excessive overgrowth of asymmetrically disposed bone bridges between the vertebrae which render the spine completely immobile yet occur quite asymptptomatically. The apophyseal joints may remain perfectly normal. It is interesting to note that when bones are thin, i.e., as in osteoporosis and osteomalacia, osteophytes are far less commonly seen than in those individuals who have a normal bone mass.

Diagnostic Guidelines: Degenerative Joint Disease (Osteoarthritis)

Definitive information
1. Eburnation
2. Grooving on articulating bony surface

Exhumed bones
1. Bones are usually of normal thickness and weight for individual's age and sex.
2. Some thickening (sclerosis) occurs below surfaces where bones are in direct contact.
3. Marginal osteophyte formation is typical but does not necessarily represent the degree of wear or indicate the amount of discomfort.
4. Pseudocyst formation may occur.

Mummified remains
1. Thinning and damage of articular cartilage (flaking and fibrillation)
2. Possible bony thickening of the joint

Gout and Pseudogout

These are clinical diagnoses indicating that the individual has experienced acute attacks of arthritis which were accompanied by the formation of a specific type of crystal which can be found in the joint fluid at the time of the attack. In gout, sodium monourate crystals are present, and at autopsy the joint lining and cartilage surface may be encrusted with a white layer of deposited sodium monourate. A peculiar feature in some cases of gout is the development of a tophus, a subcutaneous focal collection of sodium monourate crystals.

Although the clinical symptoms may be similar in pseudogout, the crystals differ in their composition and have been identified as calcium pyrophosphate dihydrate. Because of their radio-opacity and their restriction to the cartilage surface, the exact radiological term chondrocalcinosis is appropriate, although it does not necessarily indicate that acute attacks of arthritis have been experienced. Naturally, the diagnosis of these two conditions can be precise only when the specific crystals are available and can be identified. For paleopathological purposes, the cartilage must be preserved and the crystals must not have been dissolved or dislodged by the act of preservation or the technique of preparing the histological specimen.

Diagnostic Guidelines: Gout

Definitive information
1. Adult male > adult female ratio 8:1 (ethnic differences)
2. Identification of sodium monourate crystals by polarizing microscopy and enzymatic digestion with uricase or x-ray diffraction study

Exhumed bones
1. Bones are usually of normal thickness
2. Joint erosions
   a. Few and asymmetrical, particularly first toe
   b. Occasional bone erosion distant from the joint
   c. Nonspecific, possibly secondary, degenerative joint changes

Mummified remains
1. Soft tissue thickening
2. Deposition of sodium monourate crystals in affected joint, olecranon or helix of ear (tophus)
3. Urate kidney stones

Diagnostic Guidelines: Pseudogout (Chondrocalcinosis)

Definitive information
1. Males = females in older adults
2. Identification of calcium pyrophosphate dihydrate crystals within the joint or articulating cartilage

Exhumed bones
1. Bones are usually of normal thickness.
2. Marked degenerative joint disease is present, greater than normally expected for age.
3. Osteophytosis is common as seen in degenerative joint disease.
Mummified remains
1. Calcification in hyaline and fibrocartilage as detected on x-ray films of knees, wrists, symphysis pubis, and at the rims of intervertebral discs
2. Deposits of calcium pyrophosphate dihydrate crystals seen grossly on exposed joint cartilage

Ochronosis
This is a very rare disease. There may be some degree of osteoarthrosis and osteophytosis in the vertebral joints leading to spinal "stiffness," but the peripheral joints more often show advanced degenerative joint disease secondary to early disintegration of the pigmented cartilage. Some observers suggest that calcium pyrophosphate dihydrate crystals may be found in ochronosis. However, in a single patient seen at Henry Ford Hospital by the authors in which joint fluid and articular cartilage specimens were examined, no crystals were identified.

The paper on ochronosis by Stenn and his colleagues (pp. 44-48) provides fairly convincing evidence of the disease in an Egyptian mummy. Nevertheless, many regard the condition in a mummy as a postmortem artifact resulting from the process of embalming. Already, numerous reports of so-called ochronosis are being received because of publicity in the Paleopathology Newsletter. It would be difficult to believe without further confirmation that a disease so rare today could have been so common in ancient Egypt. Thus, in spite of the findings reported by Stenn et al, we must reserve judgment until further facts are available.

Diagnostic Guidelines: Ochronosis

Definitive information
1. Chemical identification of the dark pigment as polymerized homogentisic acid

Exhumed bones
1. Degenerative changes in the hips, knees and shoulders
2. Nonspecific bony changes

Mummified remains
1. Calcification (radio-opacity) of cartilage, particularly in intervertebral discs
2. Black or dark-brownish pigmentation of cartilage of the joints, ears, nose, sclera
3. Pigmentation of tendons of the hands and feet

Rheumatoid Arthritis
Numerous authors have emphasized that the precise diagnosis of rheumatoid arthritis with modern criteria may still be quite difficult even with the added advantage of radiographic evidence and very sophisticated chemical, blood and histological studies. There are many who still believe that arthritis occurring with psoriatic skin lesions is often rheumatoid arthritis in disguise. It is not surprising, then, that clearcut paleopathological diagnoses may also be fewer than expected in a condition which requires numerous separate points for specific classification.

This lack of more precise documentation of rheumatoid arthritis is also corroborated by those two spheres which have been able to shed historical light on this subject—pictorial and literary expression. Jan DeQueker reported in the British Medical Journal in 1977 that close scrutiny of many of the paintings of Flemish artists revealed arthritis in the fingers and hands of some of the subjects, although definitive changes could not be clearly established. However, the clinical descriptions of rheumatoid arthritis found in older literature were often imprecise or partly obscured by the translation and possibly by the fact that in historical times, as well as at the present, nonlethal diseases did not gain as much clinical attention as those causing life-threatening situations. The descriptions of possible rheumatoid arthritis that can be found before the 18th century are singularly few. Recently, however, a most interesting description from about 1230-1250 was kindly brought to our attention by Dr. Stanley Rubin of Liverpool, England. In a treatise entitled De Proprietatibus rerum (Book seventh—on Medicine), Bartholomeus Anglicus described various types of arthritis and stated:

One form of the disease is worse, for it draws together tissues and makes the fingers shrink and shrivels the toes and sinews of the feet and of the hands. This form draws out and wastes substantial humor in the hands and makes them dry and crooked and closed and incapable of being opened. Also it makes the joints of the fingers unsightly with knotty bunches and this sickness must be treated soon, for when it is old, it is curable with difficulty especially after it is turned into knotty hardness.*

One of the features of rheumatoid arthritis is its capacity to disable the subject. It usually has a protracted course and is associated with a generalized osteoporosis affecting all bones in addition to the thinning of bone adjacent to the affected joints. The joints most severely involved with bone erosions show little evidence of effective repair or sclerosis. While knees, hips and the cervical spine are often involved

* The translation of this treatise by J.J. Walsh appeared in Medical Life, 40 (12):545-602, 1933.
in both degenerative joint disease and rheumatoid arthritis, the simultaneous involvement of the metatarsophalangeal and the metacarpophalangeal joints of the hand is a peculiarity of rheumatoid arthritis. In essence, it is a bone eroding disease and produces localized thinning of bone and articular erosions.

In those areas of most typical rheumatoid change the bone has the thinnest cortex and the thin trabeculae are more susceptible to artifactual changes and to natural dissolution when exposed to the elements. Erosions also occur in the larger joints (knees, hips, elbows, etc.), but they are not so specific. In rheumatoid arthritis, there is a tendency to develop bony fusion across the joint but only after extended periods of immobility associated with contractures. The osteophytes produced are usually small and very fragile, possibly because of the generalized and localized osteoporosis. When the hips and knees are involved, the damaged joint may develop secondary degenerative changes.

Children with rheumatoid arthritis do not follow the adult pattern, and the joints affected are often asymmetrical. In juvenile rheumatoid arthritis, fusion may be seen in the cervical spine more than in any other joint and the vertebral bodies often remain small. It is, in fact, a form of spondylitis, but it does not, as a rule, involve other parts of the vertebral column. By contrast, the cervical spine involvement of adults with rheumatoid arthritis is an erosive process that mainly affects the apophyseal joints with resulting instability.

Diagnostic Guidelines: Adult Rheumatoid Arthritis

Definitive information
1. Adult female > adult male 3:1
2. Pattern of affected joints is suggestive
3. Nonspecific erosions of individual bones

Exhumed bones
1. All bones usually thinner than normal, eroded around periphery of articular surface, few osteophytes
2. Usually symmetrical joint involvement
3. Joint distribution
   a. Metacarpophalangeal joints most affected in hands, distal interphalangeal joints rarely
   b. Metatarsophalangeal joints most often affected in toes, other digit joints rarely
   c. 2nd to 5th metatarsophalangeal joints rarely damaged in other diseases
   d. Knees and hips: when involved, secondary degenerative joint disease (osteoarthritis) may be superimposed so that it obscures the basic disease.
   e. Cervical spine often becomes unstable in the adult and may fuse in children.
4. Fusion of joints possible after long period of immobility of joint

Mummified remains
1. Symmetrical joint distribution
2. Soft tissue thickening of affected joints
3. Subluxation, deviation and deformity of hand and fingers
4. Contracture of elbows, hips or knees in severe cases

Spondylitis and Spondylosis

These conditions are associated with some degree of “stiff spine.” Ankylosing spondylitis is a disease that requires the involvement of sacroiliac joints with erosion and subsequent bony fusion. Concurrently, there may be vertebral ankylosis by the deposition of mineral with ultimate ossification deep to the longitudinal ligaments that produce “squaring” of the vertebrae.

While the tissue typing test HLA B-27 can distinguish early clinical cases of ankylosing spondylitis, the applicability of this procedure to mummified tissue is not yet possible. The term spondylosis, by contrast, includes varying degrees of osteophyte formation around the apophyseal joints and/or about the vertebral bodies themselves. In this situation, the sacroiliac joints are not affected.

Diagnostic Guidelines: Ankylosing Spondylitis (Sacroiliitis)

Definitive information
1. Young adult male > female (ethnic differences)
2. Bony fusion of sacroiliac joints

Exhumed bones
1. Vertebral bones are thinner than normal.
2. Sacroiliac joints initially erode and later fuse as seen by x-ray films.
3. Intervertebral and osteovertebral joints may fuse.
4. Symmetrical ossification with small syndesmophytes may involve any part of the anterior or lateral longitudinal ligament of the spine.
5. Large osteophytes are uncommon.
6. Hip and shoulder joints in 30% initially erode and may fuse (incidence of change is 10% in other joints).
7. There is a tendency to progress to marked kyphosis.

Mummified remains
1. Nonspecific: spine may be markedly kyphotic or straight, thus affecting posture of mummy.

Diagnostic Guidelines: Spondylosis

Definitive information
1. Marked osteophyte formation of the vertebral column

Exhumed bones
1. Bridging of vertebral discs produces a “stiff spine.”
2. Degenerative joint disease may co-exist.
3. Sacroiliac joint disease is normal.
4. Osteophytes are often large and symmetrical.

Mummified remains
1. Nonspecific: spine usually straight

Infections
Osteomyelitis and septic arthritis are often associated with considerable bone destruction, but there are rarely any features to permit identification of the specific organism involved. The etiology of the joint pathology can be established with a greater degree of certainty if other sites of the body are involved, as occurs in tuberculosis and syphilis, for example.

Miscellaneous
Many other separate arthropathies can be identified clinically, but they are much less common and frequently do not have any distinctive bony changes. Perhaps the grossly disorganized joint — neuropathic or Charcot’s joint — might be identified, but whether it was secondary to diabetes mellitus, syphilis, peripheral neuritis, or spinal cord lesion would be determined by co-existing factors at some other site, but may not be identified in other components of the bony skeleton.

Conclusion
It is apparent that although joint diseases often provide distinguishing and diagnostic bony features, many of these bone changes are late in the disease and nonspecific. In mummified tissues, some clues to the underlying joint problem may be found locally by radiographs showing soft tissue as well as bone detail. Histological examination of the cartilage and periarticular material is also important. The crystal deposition diseases — gout and pseudogout — present the unique opportunity of a definite diagnosis if the crystalline material is preserved. Although gout has been identified in ancient bodies, the newer disease, pseudogout, has not been reported in antiquity.