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DISPLACEMENT OF THE UPPER FEMORAL EPIPHYYSIS
IN THE ADOLESCENT

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This disease, also known as epiphyseolysis capitis femoris, adolescent epiphyseal coxa vara, or epiphyseal coxa anteverta, is the most dangerous and most common disease of the hip joint affecting the adolescent, causing the destruction of the upper capitate epiphyseal cartilage with upward displacement and anteverision of the femoral neck upon the capitate femur. The danger arises from the fact that the symptoms and physical signs are oftentimes so mild and transient as to escape attention or be ignored by the patient and physician. The resultant destruction, malformation and disturbed mechanics of the hip joint will produce disabilities in later life, which are crippling at times to the degree of complete disability.

Tuberculosis, non-articular arthritis (rheumatic or otherwise) and other disorders will destroy the joint, but the symptoms are so severe that attention is focused on the involved structure and appropriate treatment may be instituted.

The etiology of this epiphyseal dystrophy or dissolution is probably an avascular or aseptic necrosis, possibly brought about by embolic disturbances in the blood supply. The cases under our care have exhibited to a greater or lesser degree the hypogonadic adiposity of Fröhlich’s syndrome which brings to attention the possibility of a pituitary dystrophy and its effect on the growth centers of bone. The lesion predominates in the male.

Trauma is a feature of the history that cannot be ignored, and usually precedes the onset of the more serious symptoms and signs. However, one has been confronted with the occurrence of like involvement in the opposite hip while the patient has been immobilized in a plaster cast for treatment on one side, without the possibility of trauma. Trauma, especially that of erect weight-bearing, undoubtedly plays the important part in the displacement of the femoral neck upon the capitate femur.

The capitate epiphysis appears to slide backward and slightly downward, but I believe the interpretation should be an anteverision and upward displacement of the neck on the capitate femur. Unlike other epiphyseal separations fragments of the margins of the diaphysis are not carried with either the neck or capitate epiphysis. The mechanism might well be likened to that of the adduction mechanisms of subcapitate fractures of the femur.
Clinically the symptoms may vary from an intermittent vague distress in the hip joint, knee, or thigh, to a severe, painful, disabling limp. Pain in the knee or thigh is more frequently encountered than pain in the hip joint. The patient exhibits an external rotation and shortening of the lower extremity, depending on the degree of displacement. Usually there is a history of a trivial twist or strain. Limitation of internal rotation of the hip joint occurs early and may be found in most cases if searched for diligently. One should employ a protractor to measure the degree obtainable; the normal range being between 50 and 60 degrees. Slight limitation of flexion at the hip joint also occurs early. The patient will generally state he has noticed limitation of motion in the hip joint making it impossible for him to do certain simple things, such as crossing the knees, squatting, etc.

In the pre-slipping stage symptoms may be entirely absent, but usually intermittent aching pain in the hip joint or thigh is manifest. Meanwhile the patient may run, jump, and pursue vigorous recreational activities and only be conscious of intermittent distress that is frequently shrugged off as “growing pains.” There is slight painful limitation of motion in all directions, though most marked on attempted internal rotation and abduction.

When displacement has occurred, the diagnosis can be made with ease. Limited internal rotation and abduction with shortening are the three constant findings. There is generally some limited motion in all directions. Pain is usually manifest when testing for motion. As the displacement progresses, fixed external rotation of the lower extremity and shortening occur, with flexion at the hip, knee and ankle. Pain is present in varying degree; usually it is difficult to bear weight on the involved side and on so doing walking evidences a limp of pain and shortening.

As healing takes place there is gradual diminution of pain but the external rotation and shortening persist; the patient retaining a limp of shortening and valgus which may or may not be noticeable until years later.

Later, in the third and fourth decades of life, painful malfunctioning hip joint disease develops with the osteoid degeneration of a superimposed chronic osteoarthritis.

There are three stages of the disease demonstrated by radiographic study; pre-slipping, displacement or fracture, and healing or chronic stages. The first or pre-slipping stage reveals pathologic changes within the epiphyseal cartilage without gross deformity of the proximal femur. Increased width of the radiotranslucent metaphyseal zone is an evidence of early metaphyseal dissolution. The diaphyseal margin of the metaphysis characteristically exhibits an irregular contour and is poorly delineated, while the respective epiphyseal border possesses a discrete relief.

The second stage, or stage of fracture and displacement, is characterized by complete dissolution of the metaphysis, with an upward displace-
ment of the femoral shaft with anteversion of the neck. The head of the femur appears to have slipped downward and posteriorly off the neck of the bone.

The third stage, or stage of healing and chronicity, is manifest by premature union or fusion between the capitate epiphysis and the femoral diaphysis, anteversion and upward displacement being maintained resulting in permanent shortening and fixed external rotation of the extremity.

The management of this problem has been most difficult and the end results disappointing because the deformity has remained uncorrected. Healing of the epiphysis will take place irrespective of the treatment employed. Repeated attempts at reduction of the deformity will result in aseptic necrosis of the capitate epiphysis by further disruption of the epiphysis and its blood supply to the femoral head. Reduction can be obtained, but its position is difficult to maintain, even when encased in a plaster hip spica.

I believe recognizing the mechanism of the deformity to be comparable to subcapital fractures of the femur has been the basic philosophy of our present successful therapeutic approach. The treatment is only applicable in the stages of the disease before complete healing has taken place, irrespective of the degree of displacement.

Under ether anesthesia, by holding the extremity (with knee flexed to 90°) and by external rotation and abduction, the neck is forced against the posterior rim of the acetabulum as a fulcrum, and the epiphyseal plate "fractured." Correction of the deformity is now carried out under x-ray control with the patient on the orthopedic table. The extremity is manipulated by a modified Ledbetter maneuver; traction, internal rotation, abduction, and slight extension. When the neck and capitate femur have resumed satisfactory alignment as demonstrated by anteroposterior and lateral roentgenograms, the parts are transfixed by a suitable Lorenzo screw. The patient is kept in bed until such time that the incision has healed, approximately ten to fourteen days, and then allowed to be ambulatory on crutches with a well leg lift, one and one-half to two inches applied to the heel and sole of the shoe. No weight-bearing in the erect or kneeling positions is allowed until complete epiphyseal union has taken place. In the present series of cases, to be reported below, this has taken place within six months. Roentgenograms are taken before leaving the hospital and at intervals of three months. The contralateral hip is also studied to determine pathology in that structure, in which case the treatment outlined above is carried out immediately.

When healing is demonstrated, weight bearing is gradually resumed to full use in a few weeks. Three months later, x-ray examination is carried out and in addition an erect posture film is taken to determine any deficiency in extremity length and its effect on the sacral base level and superincumbent lumbar spine. Corrective lift therapy is applied to correct any altered vertebral mechanics that may be discovered. It is
recommended that serial roentgenograms be made at intervals of six to twelve months until epiphyseal growth ceases.

All cases treated thus far have been placed on a high potency vitamin and mineral therapy designed to improve metabolism of bone. It would appear that healing has been more rapid under this regime; general health is improved and the obesity lessens. The regime used at present is as follows: "Catalyn," VP Cataplex C, VP Cataplex F of each two tablets twice daily taken one-half hour after breakfast and one-half hour after dinner. In addition at bedtime one tablet VP "Minaplex" (organic colloidal minerals) followed by VP Phosphade (organic phosphoric acid) one teaspoonful in a glass of water.

If avascular or aseptic necrosis of the capitate femur has occurred conservative measures should be employed. Freedom from weight bearing while the bone remains plastic is imperative to reduce deformity and restore hip joint movement. The most readily applied treatment is the use of the well-leg lift which is continued until there is radiographic evidence of restoration of normal opacity of bone. Walking caliper braces may be applied after a period of several weeks of recumbent rest. The patient should be warned against kneeling. The employment of the vitamin regime mentioned previously has been used for the past several years, we believe, with good effect, lessening the period of convalescence materially.

The management of the neglected and healed upper femoral epiphysiolysis with displacement is an individual problem. Usually some reconstructive surgery is necessary to relieve pain and improve function. Subtrochanteric osteotomy to improve angle of weight bearing or reconstruction operations of Albee, Colonna, and Whitman, are the usual procedures depending upon the individual circumstances.

Case Reports

Case 1. F. G., No. 15740, a fifteen year old male, admitted to the Osteopathic Hospital of Philadelphia on January 27, 1944. Three months previously he had fallen from a ladder striking the left hip, and on arising was unable to walk because of pain in the left hip joint. He remained in bed for several weeks and was then able to walk with a rather pronounced limp on the left side, and continued to do so until two weeks before admission to the hospital when he presented himself at the Clinic for attention. The patient exhibited a limp of shortening and pain, limited abduction, flexion, and internal rotation. In standing and walking the entire extremity was externally rotated and he walked on the metatarsal region with the heel off the ground with flexion at the knee and hip joints. X-ray study revealed epiphysiolysis (coxa antverta) compatible to the second stage of the disease. On January 29, two days after hospitalization, under pentothal sodium anesthesia a Steinman pin was inserted through the shaft of the left femur approximately four inches above the articular margin and fifty pounds of skeletal traction applied, which was continued day and night. On February 2, 1944, x-ray
study revealed no appreciable change in the relationship of the involved parts considering the findings noted at original examination. On February 5 under ether anesthesia the epiphyseal line was mobilized or "fractured" by means of the flexion-external rotation-abduction maneuver. He was then placed on the orthopedic table and the alignment between the capitae femur and the cervical portion of the femur reestablished by traction, internal rotation, abduction, and slight extension under roentgen control. A four inch Lorenzo screw was employed to transfix the capitae femur and cervical femur under roentgen control. The Steinman pin was removed as being of no further use. The patient made an uneventful recovery and was discharged from the hospital on February 18, 1944, after postoperative x-ray films revealed the left femoral-cervical-capitae relationship to be quite satisfactory. The patient was fitted with a well-leg lift and elongated crutches and instructed not to bear weight on the left lower extremity, either in the standing or the kneeling positions.

The patient was reexamined five months later at which time x-ray studies revealed the alignment to have been maintained satisfactorily but with incomplete healing. Subsequent studies have revealed complete healing.
CASE I.

Five months later, position maintained with incomplete healing.
Case II. D. L. B., No. 15170, a thirteen year old male, was admitted to the Osteopathic Hospital of Philadelphia on November 22, 1943. Six months previously he had experienced stiffness of the inner and posterior aspects of the left thigh, was unable to adduct the left leg over the right, and experienced a limp, on weight-bearing and walking. There was no severe pain during this time. He was under the care of several physicians until referred to us by Dr. John D. Devine, Ocean City, New Jersey, on November 17, 1943. Three weeks previous to the time of my examination pain became quite severe throughout the thigh, and extended down the front of the leg. The patient stated that he fell on the left knee about one week prior to the onset of the severe pain. Examination revealed a rather typical Fröhlich's syndrome, and walking with a rather pronounced limp of shortening and pain on the left side with the extremity held in external rotation. Flexion, abduction, and internal rotation of the left hip joint were limited and slightly painful. The diagnosis of epiphysiolysis of the left capitate femur was made which was confirmed by x-ray studies the same day.

Two days before admission to the hospital the patient fell while playing football, and suffered such severe pain in the left hip and marked external rotation of the left lower extremity that it was almost impossible for him to walk. X-ray study on admission revealed a severe second degree epiphysiolysis, the recent injury probably having caused further displacement of the epiphysis. On November 24 a 3/32 inch Steinman pin was inserted in the distal femur approximately four inches above the articular margins and fifty pounds traction applied. On November 29 x-ray study revealed correction of the displacement comparable to the studies made on November 17. On December 1 under spinal and pentothal sodium anesthesia strong traction made on the Steinman pin on the orthopedic table together with internal rotation, abduction, and slight hyperextension reduced the deformity with satisfactory relationship of the left femoral-cervical-capitate region, under roentgen control. Alignment was maintained by 3-1/4 inch Lorenzo screw inserted under roentgen control. The Steinman pin was removed. The patient was discharged from the hospital on December 22, 1943, after postoperative x-ray studies revealed satisfactory relationship between the involved structures. The only complaint from the patient was pain and stiffness in the left knee joint which was gradually clearing up on discharge. The patient was fitted with a well-leg lift and elongated crutches and instructed not to bear any weight on the left lower extremity in the erect or kneeling positions.

The high potency vitamin and mineral therapy mentioned previously was started while in the hospital and continued at home.

On April 3, 1944, the patient was reexamined revealing motion of the left hip joint to be within normal limits, and comparable to that of the right hip joint. X-ray study revealed complete correction of the pre-existing epiphysiolysis and displacement, but it was felt that further freedom from weight bearing should be continued until roentgen evidence of
CASE NO. II. D.B.
Pre-operative study, epiphysiolysis showing marked displacement of epiphysis.

CASE NO. II. D.B.
Immediate post-operative study, reduction and transfixation.
CASE NO. II. D.B.

Complete healing of epiphyseolysis six months later.

Complete healing could be demonstrated. On June 13, 1944, the patient was again examined at which time x-ray studies revealed complete union and healing of the epiphysiolysis on the left side, while the epiphyseal relationship on the right side remained normal. At this time all restriction of weight bearing was removed. As last reported by Dr. Devine, the patient appeared to be quite normal, there has been reduction in the adiposity and the patient has resumed his normal life.
Case III. F. A. W., No. 15934, a fourteen year old male, was admitted to the Osteopathic Hospital of Philadelphia on February 17, 1944. About one year previously the patient developed a rather abnormal gait and while under the care of a physician a short right leg was noted and lift therapy employed. Two weeks prior to admission the patient fell while walking and on arising found it impossible to bear weight on the left lower extremity. The patient was brought to the Accident Ward of the hospital at which time x-ray studies were made revealing bilateral epiphysiodesis of the capitate femora.

The patient exhibited a rather typical Fröhlich's syndrome. There was almost complete limitation of motion of the left hip joint, all motions being extremely painful, with the extremity held in slight flexion at the knee and hip joint and in fixed external rotation. The right hip joint exhibited limited flexion, abduction, and internal rotation, but was not painful.

On February 23 under ether anesthesia the epiphyseal plate on the left side was mobilized by the flexion-external rotation-abduction maneuver, the patient transferred to the orthopedic table and satisfactory alignment between the femoral-cervical-capitate structures obtained by internal rotation, abduction, and slight extension. The parts were transfixed by a 3-1/4 inch Lorenzo screw under roentgen control. On March 3 under pentothal sodium anesthesia this same procedure was carried out on the right hip joint. The patient made an uneventful recovery and was discharged from the hospital on March 11, 1944, x-ray studies having been taken the day before discharge revealing satisfactory alignment of the parts. The patient was instructed to remain in bed for a period of three months after which time reexamination was to be made. The patient was placed on a high potency vitamin and mineral therapy as described previously and was instructed to continue this treatment at home.

On June 9, 1944, x-ray study of the hip joint revealed satisfactory alignment of the femoral-cervical-capitate structures of both femurs and although there was evidence of healing, it was deemed insufficient to allow weight bearing. In the right femur rarefaction of bone was demonstrated about the engaged end of the screw on either side of the metaphysis, probably aseptic necrosis. Continued absence from weight bearing was carried out while the patient continued the vitamin and mineral therapy.

On August 1 x-ray study revealed further extension of the aseptic necrosis about the engaged end of the screw on the right side and removal of the screw was recommended. On August 3 under pentothal sodium anesthesia the Lorenzo screw on the right side was removed. Cultures of the secretion from the bone channel were negative for micro-organism. X-ray study of the left hip joint at this time revealed satisfactory healing of the epiphyseal structures. A well-leg lift was applied to the left side and the patient made ambulatory with elongated crutches, with no weight bearing permitted on the right side. This patient is still under treatment.
FEMORAL EPIPHYSEAL DISPLACEMENT

CASE III. F.W.
Pre-operative study. Bilateral epiphyseolysis with displacement of capitate epiphyses.

CASE III. F.W.
Reduction and transfixation. 3/10/44.
and may be for some time until the aseptic necrosis of the capitate femur on the right side has healed.

**Conclusion**

This procedure supersedes all other methods of treatment in our estimation for several reasons: 1. Deformity is corrected and normal joint mechanics restored. 2. The period of disability is markedly reduced in comparison with other methods of treatment. 3. The procedure entails hospitalization with economy of bed space. 4. The cost of treatment to the patient is materially lessened. 5. Complete restoration of a normal hip joint and knee joint function is effected. 6. Strong skeletal traction is of little or no value except as a part of the reduction maneuver. 7. Fixation must be strong enough to prevent recurrence. 8. Transfixation by suitable hip screws or nails is a most satisfactory method.

**References**

The first report of this disease to appear in the literature was made by Filatow, a Russian physician, in 1885. He described it as an idiopathic lymphadenopathy occurring in children. In 1889, Pfeiffer described and reported a disease he called "glandular fever." His clinical description was very thorough and extremely accurate and coincides entirely with our present knowledge, except that he failed to describe any blood changes. Following Pfeiffer's description of glandular fever there appeared from time to time rather frequent mention of the disease with occasional epidemics, thereby establishing it as being both infectious and contagious. The first reported epidemic to occur in this country was the Ohio epidemic. This was reported by West in 1896, who reported 96 cases, all involving children. Terflinger was the first to report the occurrence of this disease in adults. In 1908 he reported 150 cases, all occurring in adults.

Burns was the first to draw attention to the blood changes. In 1909 he reported that the small mononuclear cell seemed to be the cell which was chiefly increased and that occasionally the lymphocytes were increased to as high as sixty-one per cent.

In 1920 Sprunt and Evans reported a supposedly new disease entity which they titled "infectious mononucleosis." Their description was that of an acute infectious disease occurring in adults with a moderate enlargement of the lymph nodes and spleen and a mononuclear leucocytosis. However, Tidy and Morley in 1921 carefully studied the blood changes during an epidemic and concluded that Pfeiffer's glandular fever and infectious mononucleosis are identical.

Since 1920 numerous reports have appeared in the literature from all parts of the world. In 1928 and again in 1930 the disease was so prevalent that it reached almost epidemic proportions.

Paul and Bunnell in 1932 made an extremely valuable observation which has been of inestimable value in the diagnosis of infectious mononucleosis. They found that the blood serum of individuals suffering with this disease contained an extremely high titer of heterophile antibodies. The heterophile antibodies were determined by the presence of agglutinins and lymolysins for the erythrocytes of sheep, and since they occurred in considerably higher titer than in any other disease, the heterophile antibody test was introduced as a diagnostic procedure. Since the original work

* Paper presented at the Pathological Conference of the Staff, February, 1940.
by Paul and Bunnell other investigators have found the heterophile antibodies always present in high dilutions in infectious mononucleosis, thereby establishing it as a test for conclusive proof of the presence of infectious mononucleosis.

**Etiology**

Although infectious mononucleosis is classified as an infectious disease the specific infectious agent is still unknown.

The disease has been reported from all parts of the world, most commonly occurring in North America, Europe, Australia, and the Orient, very rarely in the tropics. There have been no reported cases occurring in negroes.

Various organisms have been isolated from the secretions of the nose, throat, gums, lymph nodes, and even the blood stream of afflicted individuals. These include streptococci, diphtheroid organisms, influenza bacilli, and the spirilla and fusiform bacilli of Vincenti. Studies on these organisms have revealed nothing significant; therefore, they have been considered secondary invaders. The high incidence of Vincent's infection has led some to believe that these bacteria are related to, or perhaps associated with, the etiological agent.

It is assumed that the infectious agent is either a bacterial or protozoan organism or a filtrable virus whose portal of entry is the mouth or nasopharynx.

The disease is more common in infancy, childhood and young adult life, although in very rare instances has occurred in elderly persons. Infants up to the age of six months seem to be immune. Both sexes are susceptible, although males seem to develop the disease more readily than females.

There appears to be no seasonal or occupational incidence of significance.

The disease is mildly contagious and under conditions favorable to contact spread may exhibit epidemic features. Single cases will often occur in a family without any other member becoming infected; however, in institutional surroundings, such as a classroom, hospital ward, etc., the disease will most often spread. Sporadic cases seem to occur in adults and epidemics in children.

The method of transmission of the disease is mainly by droplet infection and fairly close contact is necessary.

The disease rarely occurs more than once in the same individual. This observation, although still unsubstantiated, suggests that immunity is conferred. The age incidence of frank attacks of the disease also suggests that immunity is acquired by the end of the third or fourth decade of life, through the usual mechanism of a mild unrecognized attack early in life.

There have been two main views reported regarding the cause of the response of the blood in infectious mononucleosis. The first view main-
tains that a special infective agent gives rise to the characteristic lymphocytic response, while a second believes the lymphatic reaction is due to an unusual constitutional disposition on the part of the patient reacting to an ordinary infection; in other words, the type of response, and not the stimulus, is the unusual feature. The first view is the more widely accepted theory at present.

Many attempts have been made to reproduce the disease in experimental animals. Murray, Swann, and Webb were successful in reproducing a similar disease in rabbits. In their experiments the bacterium monocytogenes was the etiologic agent for producing a disease characterized by monocytosis in rabbits. Further work was done by Nyfeldt in 1929 and more by Bland and Hunt in 1930; however, these experiments, important as they seem, have not been adequately confirmed.

Much of the evidence at the present time points to a virus as the etiological agent and for the present this view seems to be the most acceptable.

**Symptomatology**

The incubation period is estimated at from five to ten days. Lehn-dorf and Schwarz have reported the incubation period as being from seven to eight days with usually short prodromal periods.

The onset of the disease is usually gradual; however, it may be severe and sudden. The patient complains of a dull headache, fatigue, and general malaise followed by fever, sore throat, and general lymphadenopathy. The cervical lymph node swelling usually appears early, as a rule during the first twenty-four hours of the disease, and may cause considerable pain and discomfort. The axillary and inguinal glands become enlarged later and may become painful and tender. Chilliness, headache, anorexia, backache, sweating, weakness, sore throat, dysphagia, abdominal pain, cough, coryza, and epistaxis are common complaints. The acute symptoms and fever may last from a few days to several weeks, one week to ten days being the average. A relapsing type of fever is sometimes encountered, which lasts for several weeks.

After studying a series of forty-five cases Canuteson classified the symptoms into four distinct types as to onset: Those with sore throat, headache and malaise, simulating an acute upper respiratory infection; those with swollen glands as the only complaint; those with a slow insidious onset over a period of two weeks or more, with complaints of fatigue, loss of weight, an occasional sore throat, subacute nasal infection, mild night sweats, insomnia, and sometimes gastrointestinal upsets, and those with a sudden onset with chills, fever, prostration, and few abnormal findings.
Physical Findings

Pharyngitis: Throat infection is present in seventy-eight per cent of all cases. The pharyngeal lesions may be either a red, granular lymph follicle hyperplasia or a follicular or ulcerative tonsillitis which may go on to suppuration, but usually does not. A pseudomembranous angina simulating a streptococcic sore throat, diphtheria, or Vincent's angina also occurs.

Lymphadenopathy: The cervical nodes just under the angle of the jaw are the first to become involved; they are first swollen unilaterally then bilaterally. Within a day or two the posterior cervical glands are involved. The cervical glands become exquisitely tender, have a soft consistency, but very rarely suppurate.

Similar although less marked swelling and tenderness of the axillary, inguinal, and deep abdominal glands occur. A few instances of mediastinal lymph node swelling have been reported.

Splenic enlargement: Splenic enlargement occurs in forty per cent of all cases. The spleen is usually only slightly enlarged in the majority of cases. Occasionally it is considerably enlarged and extends two inches or more below the costal margin and may produce considerable pain.

Fever: Fever is almost always present, accompanied with malaise, headache, and in some cases, sweating and chills. The temperature ranges from 100 to 103 F. and may last from three to four weeks. The fever is usually of a hectic type and in some cases the febrile peaks may reach 105 F. Subsidence of the fever is sometimes by crisis but usually occurs by lysis. The pulse rate is invariably in proportion to the temperature.

Miscellaneous findings: Other findings occurring more rarely are rashes, varying in type, and conjunctivitis of a dry, catarrhal type.

Laboratory Data:

With the exception of the blood cytology the majority of the laboratory procedures are negative. A mild, transient febrile albuminuria occurs in about one-half the cases. Other examinations such as the blood Wassermann test, Widal reaction, blood cultures, and the usual blood chemical examinations yield uniformly negative results.

Various organisms may be recovered from the nose and throat, none of which are specific and all of which are considered secondary invaders of areas of devitalization. Vincent's organisms can be found without exception in all membranous lesions.

The study of the blood changes in infectious mononucleosis is extremely interesting and yields a great deal of information. The most important feature of the blood count is the leucocytosis which is the result of an absolute increase in the lymphocytes. This lymphoid leucocytic increase is sometimes associated with a more or less relative neutropenia. The erythrocytes, hemoglobin, and blood platelets are essentially normal
in the uncomplicated case. The total leucocyte count varies from five thousand to thirty-five thousand, with from ten to twenty thousand being the average. McKinlay in reporting on fifty cases, all university students, states that the initial white count was 5,000 or less in eleven of fifty cases and reached a minimum of 3,300 in one case and in four of the eleven never reached a level of 10,000. The maximum count was 32,500. Leucocytosis of 10,000 or over occurred at some time in forty of the fifty cases. The differential study of the leucocytes reveals a lymphocytosis, relative and absolute of fifty per cent or greater being present in all cases at some time during the course of the disease. The lymphocyte response is unusual in that most of the cells are abnormal; usually they are the large, atypical basophilic lymphocytes which show a tendency to develop into plasma cells. Their nuclei are often indented, bean-shaped, or horse-shoe-shaped, but may be perfectly round. The chromatin structure is much less compact than that of the normal lymphocyte and nucleoli are present on occasion. The cytoplasm is of greater volume and fine azure granulation is much more profuse than in the normal lymphocyte.

A typical blood count at the height of the disease would be as follows:

Erythrocytes: 4,000,000 per cu.mm. (or over)
hemoglobin: 80% (or more)
leucocytes: 20,000 per cu.mm.
Differential:

lymphocytes 70%
mononuclears 6%
polymorphonuclear neutrophiles 20%
" eosinophiles 1%
" basophiles 0-1%
myelocytes 0
juveniles (Schilling) 0-1
stabs. (Schilling) 0-10
segmenters (Schilling) 5-10

The presence of neutrophiles and a shift to the left in the Schilling sense has been reported by Downey.

The relative lymphocytosis may persist for a period of several months following recovery.

The heterophile test is an agglutination test which depends upon the agglutination of sheep erythrocytes by heterophile anti-sheep agglutinin developing in infectious mononucleosis where a titer of over 1:224 may be considered diagnostic unless the patient is suffering at the time of examination from serum disease or has recently recovered from it.
Complications

Complications are very unusual in the majority of cases although swelling of the lymphatic glands may persist for as long as twelve months or more. The complications which have been reported as having occurred are suppurative adenitis, otitis media, bronchopneumonia, meningitis, septicemia, and hemorrhagic nephritis.

Differential Diagnosis

There are many conditions which can be confused with infectious mononucleosis and which may sometimes be difficult to differentiate. Such diseases as measles, whooping cough, influenza, typhoid fever, malaria, tuberculosis, syphilis, serum sickness, Hodgkin’s disease, lymphatic leukemia, and leukosarcoma all produce a similar lymphatic reaction.

The most common confusion arises from influenza, lymphatic leukemia, tonsillitis and pharyngitis of other origin, with secondary adenitis.

Prognosis

The prognosis is universally good. No fatalities have been reported in the literature at any time in uncomplicated cases. However, a few deaths have been reported from secondary pyogenic complications.

Treatment

The treatment of infectious mononucleosis is entirely supportive, there being no specific treatment reported in the literature to date.

Rest in bed is imperative, especially during the febrile period.

General hygienic measures should be employed in regard to the oral and oropharyngeal lesions.

Careful attention should be given to all processes of elimination.

The diet should be light in type but as nutritious as possible and high in vitamin content. The use of supplementary vitamin therapy is supposed to be of some value.

In cases with heavy Vincent’s infection, with high toxicity, marked leukocytosis and high fever, the use of two or three small doses of neo-arsphenamine intravenously may be very effective.

The use of sulfanilamide early in the course of the disease has been reported to shorten its course.

Case Report

I

G. N., a female, 31 years of age, was admitted to the hospital on December 22, 1939 complaining of dizziness, headache, evening elevation of temperature, night sweats, morning sore throat, cough, and pain in the lower part of the left side of the chest.

It was the patient’s impression that her illness had its onset approximately one month previously when she caught a cold which seemed to linger on.
She had been confined to bed at home for four days under the care of a physician.

The patient’s history was otherwise negative and had no relation to her present condition.

Physical examination revealed a moderate amount of gingivitis, subacute sinusitis, and pharyngitis, membranous in type. The anterior and posterior cervical lymph glands were markedly enlarged, the axillary lymph glands were moderately enlarged, and the spleen was easily palpated and was definitely enlarged. Blood pressure was 98 systolic and 60 diastolic, and the pulse was 100 per minute. Respirations were 22 per minute. The temperature was 101.4 F. orally.

The patient ran an evening elevation and morning remission of temperature for a period of seven days following admission. The highest elevation was 102 F., orally, on the sixth day following admission. This elevation was accompanied by an attack of pharyngitis, increased swelling of the anterior and posterior cervical lymph glands and increased leucocytosis. Within a period of twenty-four hours the temperature had returned to normal and the cervical lymphatic enlargement had considerably subsided. From then on the patient made an uneventful recovery and was discharged from the hospital on January 7, 1940. Total stay in the hospital of sixteen days.

**Laboratory Findings:**

The Wassermann and Kahn tests were negative.

The Widal test was negative using the whole bacterial and “H” and “O” antigens. The heterophile study was positive in dilutions as high as 1:896.

Cultures revealed the following: Nose, non-hemolytic staphylococci; throat, non-hemolytic streptococci, staphylococci, diphtheroids, and gram positive diplococci, and gums, hemolytic streptococci, staphylococci, sarcinae, and a slender bacillus unidentified.

Direct smears of the gums revealed the following: debris, occasional pus cells, epithelial cells, a moderate number of spirilla and fusiform rods, staphylococci, and occasional streptococci.

The urine was negative throughout the course of the disease.

On repeated blood counts the erythrocyte count and hemoglobin varied but very slightly throughout the course of the disease, the average being 4,500,000 per cu. mm. erythrocytes and 92 per cent hemoglobin.

The variations in the leucocytic response as charted below indicates the transition from a leucocytosis with an absolute increase in the lymphocytes and mononuclear cells, as well as a relative neutropenia early in the disease, to an approximately normal total leucocyte count with an absolute lymphocytic leucocytosis and normal monocyte count at the time of recovery.
Treatment:

The treatment rendered was entirely supportive in nature and consisted principally of osteopathic manipulative therapy given four times daily.

**Case Report II**

A male patient, A. M., 20 years of age, whose occupation was a student, was admitted to the hospital on May 17, 1938 supposedly suffering from a severe attack of influenza.

His chief complaint was constant fatigue, muscular aches and pains, and sore throat. The fatigue and sore throat had been present for a period of two months and had been refractory to the usual methods of treatment. The fatigue had been unaltered by rest. The general health of the patient had been apparently normal until the onset of the present condition.

The remainder of the history was negative except for two attacks of pneumonia at ages 10 and 17.

Physical examination revealed a slight amount of gingivitis, subacute sinusitis, and pharyngitis. Cervical adenitis with involvement of the anterior and posterior cervical glands was present. Blood pressure was 98 systolic and 35 diastolic. The temperature was 103 on admission and the pulse 100. Respirations were 28 per minute.

**Laboratory Findings:**

Blood cultures were negative. Cultures of the nose and throat showed non-hemolytic staphylococci and streptococci. Urine cultures showed the presence of staphylococci. Direct smears of gums and throat indicated the presence of spirilla and fusiform bacilli of Vincenti. Roentgen examination of the chest and sinuses revealed the following: Lung fields were negative, and ethmoids and left antrum positive. Blood sedimentation rate was 2 mm. in 1 hour. The heterophile antibody study was positive in dilutions as high as 1:224. Daily blood counts revealed an unaltered hemoglobin and erythrocyte count. The mean average leucocyte count for the course of the disease was 16,000 per cu. mm., the lowest leucocyte count being 7,000 and the maximum 25,000. The mean average total neutrophile count was 34.5 per cent with a minimum of 8 per cent and a maximum of 61 per cent. The mean average total lymphocyte count was 62 per cent with a minimum of 34 per cent and a maximum of 90 per cent. The mean average monocyte count was 8 per cent with a minimum

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of 1 per cent and a maximum of 15 per cent. The leucocyte response charted below illustrates relatively the same transition as reported in case I.

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The most characteristic cell was found to be an abnormal form of large lymphocyte, which corresponded very closely with the cell reported by Downey as being the most typical cell found in infectious mononucleosis.

The patient ran an intermittent type of fever for a period of fourteen days following admission to the hospital, with characteristic evening rise and morning remission, the highest febrile peak being 104.8 F. on the thirteenth day, following which the temperature returned to normal within twenty-four hours and remained within normal limits for the duration of his stay in the hospital.

Treatment consisted mainly of osteopathic manipulative therapy given four times daily throughout the course of the disease. In addition to the usual supportive measures, four transfusions of 250 cc. of whole blood each were given on alternate days during the first ten days of the disease.

He was discharged on June 16, 1938 after a total stay in the hospital of thirty days.
RUPTURE OF THE HEART IN CORONARY OCCLUSIVE DISEASE: AUTOPSY REPORT OF A CASE*

Otterbein Dressler

Professor of Pathology in the College and Special Deputy Coroner, City of Philadelphia

In previous communications we have reported cases of hemopericardium due to rupture of the aorta. The present case was approached with the same possibility in mind. In this instance, however, hemopericardium had resulted from rupture of the heart through an infarction of the posterior wall of the left ventricle.

Clinical Data

"Unknown at this time. Deceased collapsed in bathroom of a friend’s home. Dead on arrival at hospital."

External Examination

The body was that of a senile, white male, said to have been 65 years old. The body length was 66 inches and the weight was estimated as approximately 150 lbs.

The scalp presented frontal baldness with a thin crop of gray hair posteriorly. A cicatrix was demonstrated over the left frontal and parietal area. This cicatrix was depressed and showed some depression of the external table of the cranium. The right pupil was somewhat larger than the left. The teeth were in poor condition with all the molars in the lower jaw missing. The chin showed a deep, old cicatrix. The finger nails and the toe nails were deformed and very irregular.

The abdomen was flaccid and sagged on either side. Hypospadias was demonstrated in the penis with the external urethral meatus located on the under surface of the distal third of the shaft of the penis.

There were no evidences of recent gross trauma to the body and no evidences of caustic poisoning.

Postmortem serology negative for syphilis by complement fixation and precipitation.

Internal Examination

The subcutaneous fat over the abdomen was 2 cm. in thickness.

The pericardium contained 300 cc. of fluid blood and a large clot representing a cast of the heart. We would estimate that this clot represented an additional several hundred cubic centimeters of blood.

*Case reported through the courtesy of Dr. Benjamin Gouley, Chief Coroner’s Physician, City of Philadelphia.
The heart measured 15 x 10 x 6 cm. The thorax measured 26 cm. in diameter at the upper level of the diaphragm. The cardiothoracic ratio was 13/26. An irregular rupture of the left ventricle was demonstrated posteriorly. This was a very ragged tear, communicating with the left ventricular cavity behind one of the papillary muscles. Upon dissection this rupture was found to have taken place through an area of infarction. The infarction of the heart was found to be due to coronary occlusive disease resulting from thrombosis of the right coronary artery. The thrombus was superimposed upon an atheromatous ulcer in the first portion of the right coronary artery. The coronary system, generally, showed an abundance of atherosclerosis. The aorta showed only moderate atherosclerosis.

There were no valvular lesions of the heart and there were no suggestions of syphilis of the aorta. The pulmonary artery did not contain any emboli.

The pleural cavities were dry but adhesions were demonstrated between the right apex in the thorax and also along the posterior border of the lung.

The lungs were comparatively pale with evidences of reinfection tuberculosis in the left apex and in the right apex. A gohn lesion was demonstrated in the lower margin of the upper lobe of the right lung. There was moderate edema of the lungs.

The esophagus presented no noteworthy lesions.

The stomach was dilated with fluid which presented the odor of wine.

The intestines presented no noteworthy lesions.

The omentum showed some adhesions about the cecum and about the spleen.

The colon presented no noteworthy lesions.

A few small diverticuli were demonstrated about the cecum, near the attachment of the appendix.

A few delicate adhesions were demonstrated about the gallbladder but the gallbladder emptied readily upon pressure.

The liver was 20 cm. tall and showed several small cavernous hemangiomas.

The pancreas presented no noteworthy lesions.

The spleen measured 10 x 11 x 3 cm. but presented no noteworthy lesions.

The prostate gland was small and somewhat adherent in its capsule. The urinary bladder shower a large diverticulum near the trigone. There was no distention of the ureters.

The kidneys measured respectively, left and right, 12 x 7 x 4 cm. and 12.5 x 6.5 x 4 cm. The capsules of the kidneys stripped with ease and several retention cysts were demonstrated in the cortex.

The suprarenal glands were somewhat hyperplastic, having an aggregate weight of 14 grams.
Anatomical Diagnosis

Coronary occlusive disease
Infarction of the left and right ventricles
Rupture of the heart
Hemopericardium
Hypospadias

Cause of Death: Rupture of the heart due to coronary occlusive disease with infarction.

Summary

An autopsy protocol of a case of hemopericardium is presented. The hemopericardium resulted from rupture of the heart. Rupture of the heart in this instance was through an infarction of the posterior wall of the left ventricle.
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