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The JOURNAL

OF THE

NATIONAL ATHLETIC TRAINERS ASSOCIATION

N A A T

12th ANNUAL MEETING

MADISON, WISCONSIN, JUNE 12, 13, 1961

THE JOURNAL of the NATIONAL ATHLETIC TRAINERS ASSOCIATION

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WILLIAM E. NEWELL, Executive Secretary
Purdue University, Lafayette, Indiana

AN OPEN INVITATION

The National Athletic Trainers Association is pleased to extend, to other than their members, an opportunity to subscribe to *The Journal,* the official publication of the association. This quarterly magazine serves as a publication source and clearing house for the research and writings about topics pertinent to the casual factors, prevention, or treatment, of athletic injuries. In previous issues have been articles authored by member athletic trainers, physicians, physiologists, physical therapists, corrective therapists, and others vitally interested in improving athletic performance or furthering the health and safety of the young men entrusted to their care. It is the sincere hope of the association that through the interchange of information by *The Journal* that all students participating in sports programs in secondary schools and colleges of the county will benefit by the greater knowledge available to us.

We hope that you will want each issue as a reference for your staff and for your student majors. Yearly subscription price is two dollars, which should be sent to Wm. Newell, National Secretary, 1104 Beck Lane, Lafayette, Indiana.

NATA PROGRAM—1961
MADISON, WISCONSIN

MONDAY, JUNE 12

8:45 A.M.—Opening Remarks, L. F. Diehm, Chairman, NATA Board of Directors.

9:00 A.M.—Welcome—Ivan B. Williamson, Director of Athletics, University of Wisconsin.

9:15 A.M.—"Panel on Unusual Injuries in Athletics," Lloyd Stein, University of Minnesota, Moderator.

10:00 A.M.—Break.

10:30 A.M.—"Injuries to the Lateral Ligaments of the Knee," Jack C. Hughston, M.D. and Kenny Howard, Auburn University.

11:15 A.M.—"The Recognition and Referral of Athletic Injuries," James S. Feurig, M.D. and Gayle Robinson, Michigan State University.

11:55 A.M.—Introduction of Exhibit Representatives, Warren Ariail, Iowa State University.

12:10 P.M.—Lunch.

1:00 P.M.—District and Committee Meetings.

2:00 P.M.—"Practical Care of the Feet in Athletics," Jay Colville, Miami University, Oxford, Ohio.

2:30 P.M.—"The Management of Knee Injuries—Post Operative and Rehabilitation," Dr. Murphy and John Payne, University of Kentucky.

3:15 P.M.—Break.

3:30 P.M.—"Panel on Basketball Conditioning," Ernest Biggs, Ohio State University; Dwayne Dixon, Indiana University; A. C. Gwynne, West Virginia University.

4:15 P.M.—Adjourn for the day.

TUESDAY, JUNE 13

9:00 A.M.—"Emergency Care for Internal Injuries in Athletics," L. W. Combs, Director of Student Health and Team Physician, Purdue University.

9:30 A.M.—"Movie—The Knee: Injury, Diagnosis, First-Aid, Surgery, Rehabilitation, and Taping." William K. Smith, M.D. and Howard Waite, University of Pittsburgh.

10:10 A.M.—Break.

10:30 A.M.—"Modern Dance Techniques—warm up exercises and specific area muscle stretching." Jane Eastham, Department of Physical Education for Women, University of Wisconsin.

11:15 A.M.—"Serious and Fatal Football Injuries Involving the Head and Spinal Cord." Richard C. Schneider, M.D., University Medical Center, University of Michigan.

12:15 P.M.—Lunch.

1:30 P.M.—"Panel on Football Conditioning," Millard Kelly, Detroit Lions Football Club, moderator.

2:15 P.M.—"Related Studies and Discussion," Leonard A. Larson, Professor and Director of Physical Education for Men, University of Wisconsin.

2:45 P.M.—Drawing of Door Prizes. Warren Ariail.

3:15 P.M.—Assemble for National Business Meeting.

3:30 P.M.—NATA 12th Annual Business Meeting.

4:30 P.M.—Adjournment.

The preceding is our program for Madison, Wisconsin, this coming June. It is hoped that all our membership and anyone interested in athletic training will be in attendance. The program is set up to be an educational and entertaining experience. The printed program, which will be available when you register, will carry a more complete description of the lectures.

TOM HEALION
1961 Program Chairman
Northwestern University

NOBODY FORGETS THE CHARM OF MADISON

June ought to be a month of thanksgiving for every citizen of Madison, whether he realizes it or not. Here he is, all year long, in the pin-up city for everybody who lives there and for thousands who don't: perennially properous capital of the state of Wisconsin; seat of Dane County, one of the richest agricultural counties in the nation. And focus of a university campus that spreads all over the state with its influence on the lives of three and a half million Wisconsin citizens.

But June's the month when trainloads and planeloads and busloads and carloads of university students leave town, some of them forever. Then, indeed, anybody who lives in Madison can feel like a privileged character—not because these young people are leaving, but because he is staying.

A melancholy graduate sits up there on the green hill below Bascom Hall, clutching his diploma, lifting his eyes once more to the white dome of Wisconsin's granite statehouse, a mile away at the other end of State Street. He remembers the feel of the canoe, soft-slipping over the Lake on a golden late afternoon . . . and the Willows, out toward Picnic Point, where he walked on a warm evening after a bout with the books.

Goodbye to all that . . .

Geography's got him—hills and lakes and trees and quiet places—just as it gets everybody who comes here. It's this kind of geography that got Madison started; made it a capital and the seat of one of America's great universities; brought in tidy and profitable industry; makes it a place you want to come back to, once you've seen it.

THE MECHANICS OF SOME COMMON INJURIES TO THE SHOULDER IN SPORTS

DONALD B. SLOCUM, M.B., *Eugene, Oregon*

IT IS the purpose of this paper to discuss the mechanics of injuries about the shoulder related to athletic trauma. Such injuries differ from those found in ordinary pursuits in that they occur, not in the normal working ranges of motion and usage, but at the extremes of motion and under conditions of severe muscular and ligamentous stress. Each sport presents its own peculiar problems related to the training and conditioning required, the conditions of play, the necessity for knowledge of game skills, the protective equipment used, and the supervision employed. This is in turn modified by the age and maturity of the participants. The growing bones, joints, ligaments, and muscles of pre-teen and teen-age competitors are subjected to unusual strain, while the more mature, game-wise college or professional athlete places fully developed tissues under stress. The aging or occasional athlete who tends to concentrate more on individual rather than team sports may present an entirely different picture. To assume that all trauma related to the field of sports could be covered here would be presumptuous; rather it is the objective of this paper to discuss some of the standard situations which have been found to be the basis of a constantly recurring pattern of trauma in the hope that a better understanding of these situations will lead to prompt recognition and diagnosis of the more common injuries, which by nature are primarily of the musculoligamentous type.

Those who first come in contact with athletics are often bewildered by the terminology used by the coach, trainer, or player to describe an injury. This terminology—some specific, some general, some descriptive, and some tinted with mysticism—has become so ingrained that there is little hope for its immediate abandonment in favor of the more precise anatomical and pathological evaluation. Since it is of definite value in understanding the general type of injury present, interpretation and translation of these terms into specific traumatic entities is desirable. Our glossary must include the following: (1) The point of the shoulder—The outer edge of the acromion process of the scapula; (2) Shoulder pointer—Contusion of the acromion and adjacent deltoid muscle; (3) Inside shoulder strain—Strain, minor tear, or contusion of the rotator cuff (supraspinatus, infraspinatus, and teres minor) (4) Shoulder separation—Sprain, subluxation or dislocation of the acromioclavicular joint; (5) Shoulder dislocation—Subluxation or dislocation of the shoulder (glenohumeral joint); (6) Shoulder nerve injury—A syndrome characterized by pain and swelling of the deltoid, weakness and numbness of the forearm and hand of five to ten minutes' duration followed by weakness of abduction of the shoulder of about two weeks' duration; (7) Knocked down shoulder—A unilateral lowered position of the shoulder. When acute, this is usually the result of trauma to the shoulder-neck interval; when chronic it is related to habitual malposture; (8) Muscle strain—Strain or tear of body of the muscle; (9) Pulled muscle—Strain of tears of muscle near its tendinous insertion; (10) Pulled tendon—Tears of the tendon at its bony insertion; (11) Glass arm—A chronic musculotendinous strain or tear of the stabilizers and prime movers of the shoulder (glenohumeral) joint associated with the throwing sports (i.e. baseball, etc.), and characterized by pain and disability after a short period of use; and (12) Collar bone—Clavicle.

The function of the shoulder is to provide a firmly anchored yet mobile base from which the arm and hand can operate in the many positions required in their use. Possessing little inherent mechanical stability, it depends upon powerful musculature and ligamentous strength for its integrity. The synchronous interplay of the four joints which form the shoulder complex provides the ultimate mobility required of the athlete. Of these, the shoulder (glenohumeral) and acromioclavicular joints are particularly susceptible to trauma due to blows, falls and overuse. The relation of posture to injury must not be overlooked. Since a well aligned machine will work more efficiently and last longer than one which is poorly aligned, it may be anticipated that in the presence of postural malalignment abnormal wear and biomechanical breakdown may result. Such malalignment may be caused by poor general posture, alteration of general posture due to injury away from the shoulder (i.e., an injured foot), to changes within the bony structure of the shoulder, or due to injury or overload of its strong supporting musculature. This predisposing factor may lead either to an acute injury or to repeated minimal injuries whose cumulative effect result in chronic affectations.

Throwing is an extremely complex motion which embodies four essential steps for its proper execution: the initial stance, the windup preparatory phase, the initial forward action of the arm prior to release, and follow-through. Although the action of the arm is the most obvious one, leg action, pivot and trunk movements are equally essential to properly executed forceful delivery. The shoulder acts like the handle of a whip, lashing the forearm and hand forward in the throwing motion. The scapula provides a firm base for the arm. It is held snugly to the chest by the trapezius and serratus. As the arm is drawn backward into a position of abduction and external rotation by the posterior deltoid, latissimus dorsi, and infraspinatus, the pectoralis major and anterior deltoid are placed on a stretch in a position of readiness for powerful contraction while at the same time the scapula is drawn backwards on the thorax by the posterior scapular muscles. The body now initiates forward motion of the arm as it moves ahead, pivots and rotates about the spine. This is followed by the synchronous movement of the scapular and humerus. The latter is now whipped into strong internal rotation and flails the forearm and hand into the follow-through position. Throwing varies greatly in different sports (baseball, football, javelin, discus, etc.), and within the same sport (fast ball and curve pitching, outfielders and catchers' throwing, etc.), due to the requirements of the game, style, physical status and the weight and distance the object must be thrown.

The application of physiologic principles will act as a guide to the mechanics of injury. Injuries to the tendon insertions and elastic elements of muscle will occur at the height of the length-tension curves of muscle. Here the muscle is stretched to a point at or near its greatest length. Resistance is largely furnished by the elastic elements of muscle of the intra- and extracellular type while the contractile element plays little part. If the muscle is overloaded at this point, further elongation will result in tears within the elastic tissues of the muscle itself, at the musculotendinous juncture or tendon insertion, or, if the tendon is degenerated, within the substance of the tendon itself. Injury to the contractile elements of muscle occur

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THE MECHANICS (Continued)

at or near the mid-point of the contractile curve which corresponds with the so-called rest length of the muscle. (This is the point to which an isolated muscle will contract when released at its extended length without stimulation of its innervation; this contraction is due to the elastic elements within the muscles.) Since muscle tension is dependent almost entirely on contractile elements, they will bear the brunt of the strain and overloading will cause injury primarily involving the muscle fibers. (Fig. 1.)

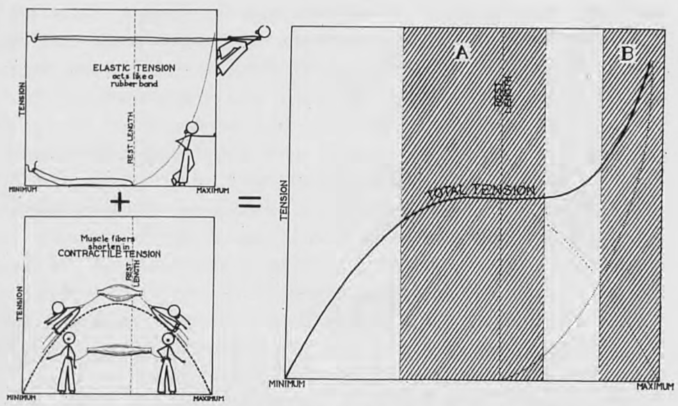

Fig. 1. The total tension curve is the sum of elastic plus contractile tension within the muscle. When the muscle is overloaded to the point of rupture, the contractile elements are most likely to tear if the muscle is in the mid-range of contraction (A) where their contribution to tension is greatest. The elastic elements of muscle are inactive at rest length and exhibit their greatest tension as the muscle is elongated towards maximum length. It is at this point (B) that the tendon may tear away from the bone, separate at the musculotendinous junction, or may actually rupture the elastic elements of the muscle.

Injury to the ligaments and joints occur when the muscles stabilizing the joints are overpowered or muscle balance during reciprocal contraction and relaxation is impaired through weakness, fatigue and incoordination.

Injury to the shoulder seldom occurs in the initial part of the preparatory phase of throwing but as the arm reaches the extremes of backward motion and delivery is initiated by a sudden strong forward motion of the body associated with pivot and forward placement of the left foot (in right-handed throwing) there is a strong tension on the insertions of pectoralis major and anterior deltoid muscles. Here injury may be incurred in one of several ways: (1) repeated check-rein action in the presence of the shortened anterior muscles, (2) the overpowering of the muscle due to excessive force applied when the muscle is already at maximum length, and (3) the tendency for luxation of the biceps tendon from the bicipital groove in the position of abduction and full external rotation (in overhand throwing). (Fig 2A.)

Injury to the insertion of the pectoralis major on the humerus occurs at the extremes of backward motion. The extended, externally rotated, and abducted humerus places the muscle on a stretch under maximal total tension. This is enhanced if flexibility has been impaired through myostatic contracture of the pectoralis major either on the basis of overdevelopment of the pectoral muscles without attendant development of the posterior scapular muscles or as a result of malposture associated with forward head and shoulders, dorsal round back, and lumbar lordosis and anterior pelvic tilt. Repeated tugging at the insertion of the muscle causes a tender painful area approximately 2 inches in length just posterior to the bicipital groove where it finds its point of bony attach-

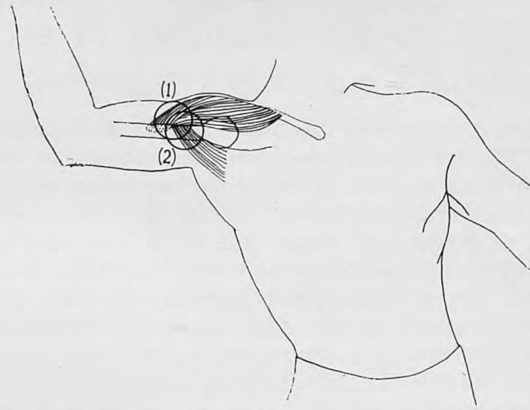

Fig. 2A. The common points of muscle injury in throwing. In the preparatory phase the insertion of the pectoralis major (2) may be irritated by check-rein action when shortened by myostatic contracture, or by added strain upon the strong elastic and tendinous elements near its insertion (2) as forward movement is initiated. The deltoid may also be injured near its anterior insertion on initial forward movement (1).

ment. This condition is often seen in baseball pitchers and javelin throwers. It is incapacitating for the sport although it may not disturb the arm in ordinary use.

The pectoralis major and anterior deltoid muscles often suffer injury to the tendon and muscle fibers near their insertions during the initial stages of forward movement through overuse in the presence of fatigue or incorrdination. At this point the body muscles are near their maximum length and the body moves forward to provide still further tension. Since the contractile power of the muscle is minimal, the full brunt of the load is born by the elastic elements so that an overpowering force will result in tears where this tissue is greatest near the insertion of the muscles. Such a situation may not only arise due to conditions intrinsic to the shoulder, but also due to postural abnormalities caused by remote injuries. It is not uncommon for a baseball pitcher with an injured toe or foot to lose the effectiveness of leg and trunk action. In attempting to compensate for this deficit of force, he may overuse the shoulder in an attempt to compensate for his lost power.

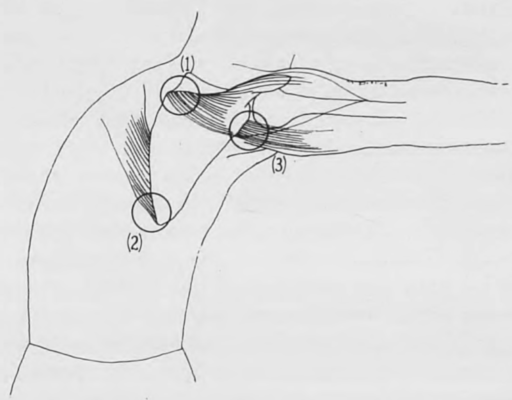

Fig. 2B. In the follow-through phase of throwing, the posterior deltoid (1), rhomboid major (2), or triceps (3) muscles may be injured at or near their insertions due to the limiting effect of elastic tension as the muscle is stretched to maximum length.

Bicipital tenosynovitis may occasionally occur in early season overhand throwing (or stretching as in tennis) because of the unaccustomed strain on the tendon in the position of full abduction, extension and external rotation where the tendon falls under maximum tension and presses firmly against the lesser tuberosity. Tenderness

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THE MECHANICS (Continued)

along the course of the tendon of the long head of the biceps both in its superficial course and beneath the anterior margin of the deltoid and pain on tension and external rotation tests are characteristic. Slipping of the tendon from the intertubercular groove is unusual in the younger group and rupture of the long head of the biceps does not occur from these particular circumstances.

On forward motion of the upper arm while throwing, three areas are commonly injured: (1) the posterior deltoid muscle near its insertion to the spine of the scapula; (2) the scapular insertion of the long head of the triceps immediately beneath the shoulder joint; and (3) the rhomboid major at the lower medial border of the scapula. Each of these occur during follow-through when the muscles come under maximum tension and elongation.

The injury to the posterior deltoid muscle usually follows overhand throwing. It occurs at the extremes of forward motion when the muscle is fully stretched. It is most likely to occur when proper "warm up" has not been carried out to insure full flexibility and coordination. Injury to the scapular insertion of the long head of the triceps is most commonly a result of curve-ball pitching. Here again the muscle is put on full stretch during follow-through and a further tug is placed on the muscle as the elbow passes into flexion; the typical pain and tenderness in the posterior axillary fold beneath the shoulder results from tears of the muscle near or at the bony insertion of the triceps muscle and is sometimes attended by periosteal new bone formation. Fibers of the rhomboid major at or near the lower medial border of the scapula may be torn during the follow-through phase of throwing. This unusual injury is more common in "underhand" throwing such as is used with the discus.

Injuries to the glenohumeral and acromioclavicular joints and their supporting ligaments result in more disability to the shoulder than is commonly found in other injuries to the soft tissue. Each will be discussed in relation to those types of injury which occur with some frequency.

The shoulder (glenohumeral) joint is frequently injured in athletics following contact with other players or contact with the ground. Since it is well protected by heavy overlying musculature, it is seldom injured by direct contact, but rather by indirect trauma when forces acting on the humerus cause it to act as a lever, prying loose the supporting soft tissues, or when forces are transmitted upward through the shaft of the humerus contusing or tearing the tissues resisting the thrust of the humeral head. The type of injury resulting depends upon the direction and power of the force applied.

Anterior dislocation is one of the most common serious injuries to the shoulder. The essential episode occurs when the head of the humerus is forced against the weak anterior capsule at any point between the bony pillar of the coracoid above and the tendinous pillar of the long head of the triceps below. The capsule and glenoid labrum are stripped from the anterior lip of the glenoid allowing the humeral head to slip into the subcoracoid region. Subclavicular dislocation with accompanying rupture of the capsule, tearing of the subscapularis muscle, and fracture of the tuberosities is rarely seen in athletic injury although some stretching and contusion of these structures occur.

The reason for the rarity of subclavicular type of anterior dislocation in sports is readily understandable: in non-athletic pursuits its usual cause is a fall on the out-stretched hand in which the body weight carries forward and the elbow flexes, throwing the arm into abduction, external rotation and extension so that the neck of the humerus is levered over the overhanging acromion and forced anteriorly out of the joint; in athletic endeavor such a fall is unusual for the trained athlete is agile and is alert to the sudden, dangerous situation.

In contact sports such as football or wrestling the injury usually occurs with the arm abducted near the horizontal so that as the humerus passes backward into abduction and external rotation the pectoralis major insertion becomes the fulcrum of the humeral lever and tends to pry the anterior capsule and labrum from their glenoid attachments. Contracture of the pectoralis major is a predisposing factor. In football, anterior dislocation is usually the result of a tackle in which the tackler looks away from his opponent and passes him too widely while attempting to grasp his thighs; the momentum of the moving player and oncominng opponent forces the abducted upper arm into full extension and levers it from the joint. All degrees of displacement may occur from anterior capsular strain to full anterior dislocation. Inferior and posterior dislocations of the shoulder are of such rare occurrence in sports that they do not warrant description here.

Sprain of the posterior shoulder joint capsule and posterior subluxation are frequent in football. They occur in unskilled players who have failed to learn the proper technic of falling in a forward position. The injury is found in ball carriers who fall forward, grasping the ball with the elbow in flexion, and light on the point of the elbow with the humerus in full forward flexion and moderate internal rotation. The force of the fall is transmitted upward through the shaft of the humerus to the posterior capsule of the shoulder joint. Pain and tenderness are found along the posterior margin of the joint and posterior instability is often present.

The rotator cuff may be injured when a player falls with his arm at his side so that force is directed upward through the shaft of the humerus sandwiching the rotator cuff between the humeral head and the overhanging acromion. The cuff may also be damaged by traction injuries. These occur when a rapidly moving player is grasped by the arm and jerked. The strong downward and lateral motion against the tensed cuff muscles may strain or tear the muscular or tendinous fibers. In blocking, an overpowering blow on the abducted arm may again strain the fibers of the cuff. In the right-handed golfer a defect of the rotator cuff on the left shoulder will often cause pain during the follow-through. In this instance the muscles of the cuff fail to snug the humeral head downward into the glenoid while the arm is thrown into full abduction and external rotation.

The clavicle is injured in a fall on the out-stretched hand with the arm in abduction and moderate forward flexion. The force of the fall passes upward through the humerus and glenoid, moves the scapula medially, and is thus expended on the clavicle. Similarly the clavicle may be injured by a fall on the point of the shoulder with force being directly inward. Direct injury to the clavicle is rare in sports and therefore fractures injuring the neurovascular bundle are most unusual.

Sprain, subluxation and dislocation of the acromioclavicular joint are simply a matter of degree. The mechanics of injury are essentially the same except for severity of the traumatizing forces. Superior and anterior dislocations are most commonly found while inferior and

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THE MECHANICS (Continued)

posterior displacements are rare. The common superior dislocation may be caused either by a fall on the point of the shoulder or a severe blow to the acromion. In either event the shoulder girdle is forced downward, resisted by the first rib and the upward pull of the sternocleidomastoid and upper trapezius. As this resistance is met the clavicle remains fixed and the shoulder girdle moves downward throwing the strain on the superior acromioclavicular ligaments which, in company with the coracoclavicular ligaments part under stress. Protective equipment, i.e., shoulder pads, materially reduce the incidence of dislocation due to blows from above; thus most injuries result from a fall on the point of the shoulder. Anterior dislocation results when an athelete arising from the prone position is "piled on" from behind. As the trunk is thrust forward, carrying the clavicle with it, it is resisted by the fixed upper extremity. The brunt of the force is born on the anterior acromioclavicular ligaments which part under the stress and allow the clavicle to ride forward. Inferior and posterior dislocations are rare and I have not seen these injuries associated with sports trauma.

The suspensory apparatus of the shoulder consists of the upper trapezius and levator angulae scapulae. These two muscles sweep down from the cervical and upper thoracic spine to attach to the acromion and spine of the scapula and serve to hold the scapula in its normal relationship with the upper thoracic cage. Injury to the suspensory mechanism may result in muscle spasm (the so-called "kink" in the neck), contusion, post-traumatic palsy or unilateral depression of the shoulder girdle. The athletic term "knocked down shoulder" applies to any condition which permits sagging of the shoulder whether it be the result of protective muscle spasm following recent injury or weakness of the suspensory apparatus following repeated minor injuries with or without secondary myostatic contracture. It is a descriptive term and not a diagnosis and as such has no particular value in the study of the injury mechanism or treatment.

The acute kink in the neck is a musculoligamentous injury of the trapezius resulting from sudden stretch of the actively contracted muscle. This usually results in minor tear of the muscle fibers at the angle of the neck. It often follows a sudden twisting movement of the neck when the head is turned to one side while reaching or being pulled by the opposite arm. The latter may occur in football in a pileup situation as the result of an unexpected arm tackle while cutting in the opposite direction or when a player looks away from an opponent and is struck on the side of the head. In wrestling, a sudden strain may precipitate the condition.

Contusion of the trapezius commonly occurs in inexperienced football linemen who flinch and look away from an opponent and receive a blow from the oncoming knee of an opponent in the shoulder pad-neck interval. Improperly applied shoulder pads (too low) or pads which are too large predispose to this injury. In other contact sports, direct injury may result from the blow of a hockey or lacrosse stick, a kick or blow from the fist.

A sudden severe stretching of the trapezius by an overwhelming force may result in a downward and forward depression of the shoulder girdle. This may cause rupture

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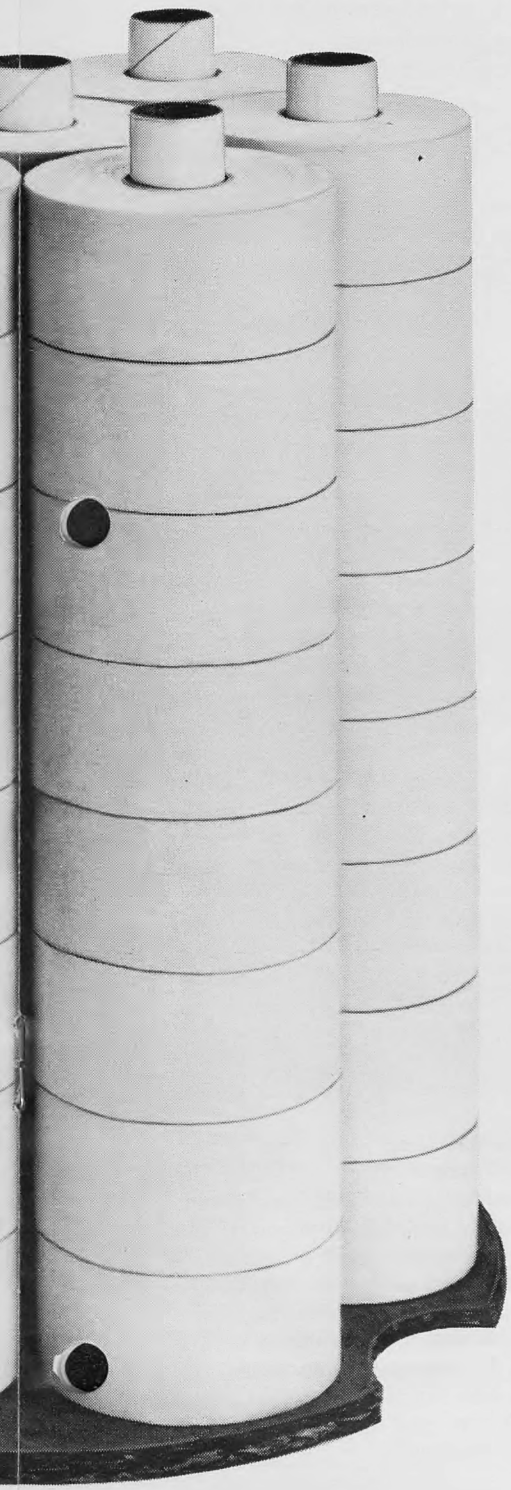

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THE MECHANICS (Continued)

of the fibers of the trapezius near their clavicular attachment together with a stretch injury or contusion of the brachial plexus. The player experiences a sudden severe pain in the neck, associated with weakness of the arm and tingling, extending downward to the fingers. This most commonly occurs in football from a blow on the top of the shoulder pads usually by the oncoming knee. The sports term applied to this situation is "shoulder nerve injury" although this term is also used for a quadrilateral space injury contusing the axillary nerve and resulting in deltoid weakness in association with posterior shoulder pain and swelling. In the posterior triangle of the neck the accessory nerve, which travels from behind the sternocleidomastoid muscle to enter the main body of the trapezius just over the clavicle (an inch or so), may receive direct trauma resulting in a mild palsy. This injury is rare in contact sports and usually follows direct injury when the player is "flinching" or "loafing."

The unilateral low shoulder ("knocked down shoulder") may result from a variety of causes. Since such factors as scoliosis, poliomyelitis, etc., have been eliminated through the pre-participation physical examination, the principal concern in supervised athletics lies in post-traumatic and postural etiology. Acute trauma to the suspensor apparatus of the shoulder girdle will cause the muscles to go into protective spasm resulting in depression by leaning to the affected side and medial displacement of the scapula. Typically, the patient will come in grasping and supporting the trapezius with his hand in the shoulder neck interval. Repeated minor traumas to the broad flat posterior muscles of the shoulder complex may also result in protective muscle spasm which draws the scapula downward and rotates the inferior angle of the scapula medially. If such a position is maintained, secondary myostatic contracture may follow fixing the shoulder in this lowered position. Sagging shoulders secondary to malposture are associated with a forward position of the head, dorsal kyphosis and lumbar lordosis. The scapula assumes a forward position accompanied by scapular rotation. The trapezius and levator angulae scapulae become overstretched and weakened. Needless to say, such a shoulder is more prone to injury than a normal one and if injured may assume a position still lower than the other shoulder. Chronic dull aching pain in the suspensory apparatus is typical.

SUMMARY

The mechanics of some common shoulder injuries occurring in sports have been discussed. Such trauma differs from that found in daily practice in that it occurs under conditions of strong muscular effort and at the extremes of motion. The appreciation of the mechanics of injury often furnishes the clue to successful early diagnosis and treatment.

PRE-GAME EMOTIONAL TENSION

By K. D. ROSE, M.D., and

S. I. FUENNING, M.D.

University Health Service, University of Nebraska
Lincoln, Nebraska

It is the practice in many colleges and universities to feed their football players a rather heavy pregame meal. This is true at our university. A training-table meal consisting of steak, potatoes, vegetables, and so forth is offered at 9:00 to 9:30 a.m. on the day of the game. This presumably serves two purposes:

1. The voracious hunger of these healthy young males is satisfied.
2. They can go into the game with the feeling that they are supplied with the needed energy to fulfill the requirements.

The meal time is supposedly far enough in advance of the game to assure complete digestion before game time. However, a certain degree of first-half sluggishness suggested that the validity of this feeding regimen should be investigated.

Recitation of a few common analogies will refresh your memory on the relationship between eating and physical and mental activity.

1. All of you who have eaten a good holiday meal recall only too vividly what you most liked to do immediately afterward.
2. Although subject to some question at the present time, the old adage of "an hour or two after eating before swimming to prevent cramps" is well known.
3. The phenomenal drowsiness of students in the one-o'clock-lecture class needs no elaboration.

If we accept the fact, then, that the post-prandial interval is attended by mental and physical sluggishness, what relationship has that to a football player fed four and one-half to five hours before game time? For a partial understanding of the relationship, let us turn to the effect of emotions on digestion. All of you have heard the reminder not to argue at mealtime, it interferes with digestion. May I quote from Cecil & Loeb's Textbook of Medicine?[1] "The symptoms of the psychophysiological disturbance in the gastrointestinal tract are the consequence of anxiety in interpersonal affairs. They may take the form of anorexia, nausea, nervous indigestion, vomiting, belching, distress from gas, and epigastric pain resulting from diarrhea and constipation." What could cause more "anxiety in interpersonal affairs" than the week to week need to be up for the big game, particularly in a relatively young man not yet accustomed to the emotional vicissitudes of this modern life as exemplified by present day college or varsity competition. The correlation between pregame tension and digestion needs no further elaboration.

In order that we not be complacent in the knowledge that our players are fed at least four hours before game time, let us examine the matter of gastrointestinal motility. Best and Taylor[2] in the Sixth Edition of their book, "Physiological Basis of Medical Practice," state this concerning the emptying time of the stomach. "In normal young males the test meal is evacuated (from the stomach) in about two hours."

Referring to intestinal motility, they have this to say. "The material (barium meal) commences to leave the stomach almost immediately after it has been swallowed; it moves steadily and at a fairly rapid rate through the duodenum and very rapidly through the jejunum. Its progress through the ileum becomes progressively slower as the ileocecal opening is approached, and in the lower part of the ileum the material tends to accumulate before it is passed into the cecum. It commences to enter the latter in about 2½ hours on the average. In four hours or so, the material arrives at the hepatic flexure and in about six hours at the splenic flexure."

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PRE-GAME EMOTIONAL (Continued)

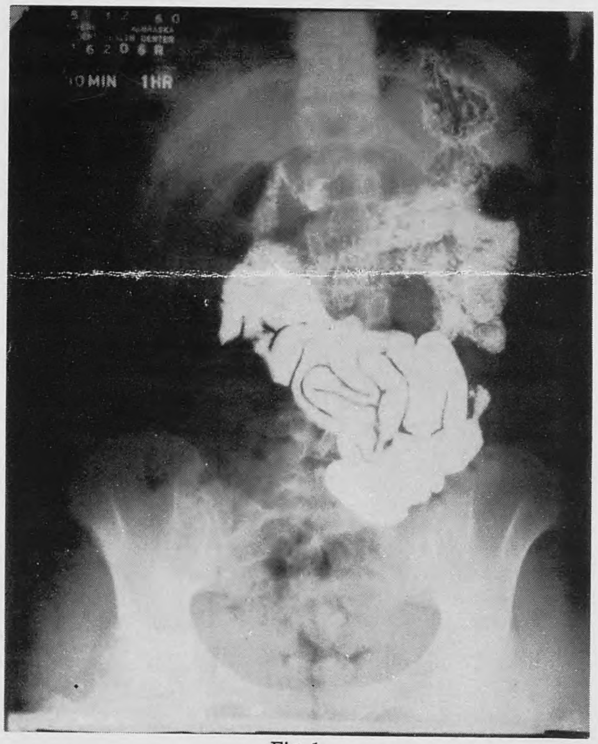

Fig. 1.

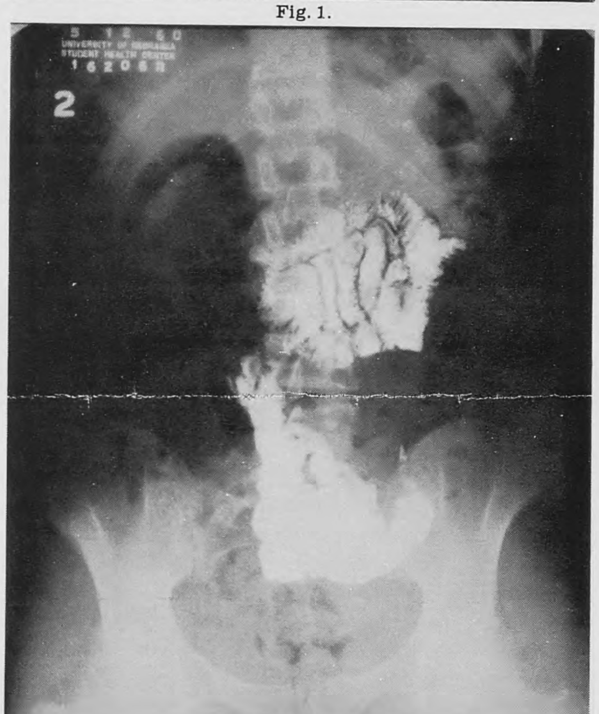

Fig. 2.

Figures 1, 2 and 3 are from a normal small bowel motility series and show a progression of barium through the stomach, duodenum, jejunum, ileum and colon at 1½, 2 to 4 hours after ingestion of a barium meal. Notice that there is still barium in the stomach at 1½ hours but that the stomach is empty at two hours. In addition, progression through the lower small bowel is on time and the head of the barium column is well into the colon at 4 hours.

In order to demonstrate the appearance of a barium meal in the stomach and upper small bowel more adequately, Figure 4 is shown. The case chosen was that of

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PRE-GAME EMOTIONAL (Continued)

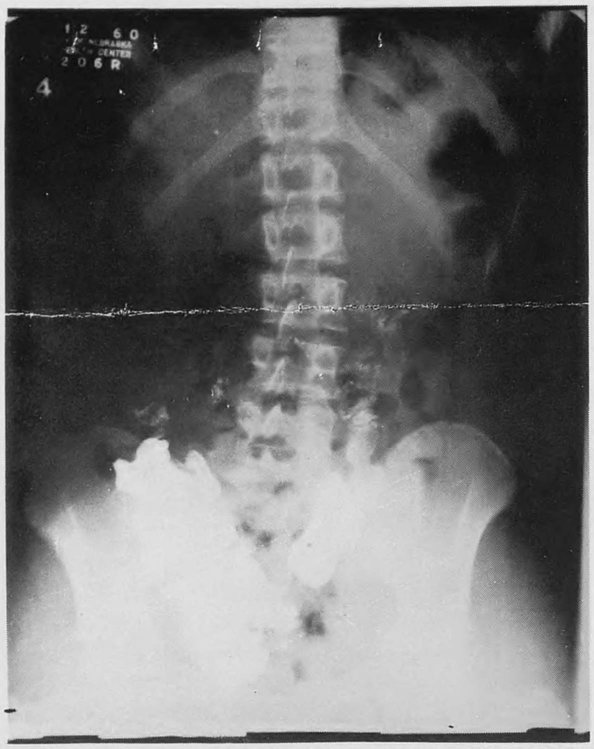

Fig. 3. Normal Small Bowel Series (Above applies to Figures 1, 2, 3.)

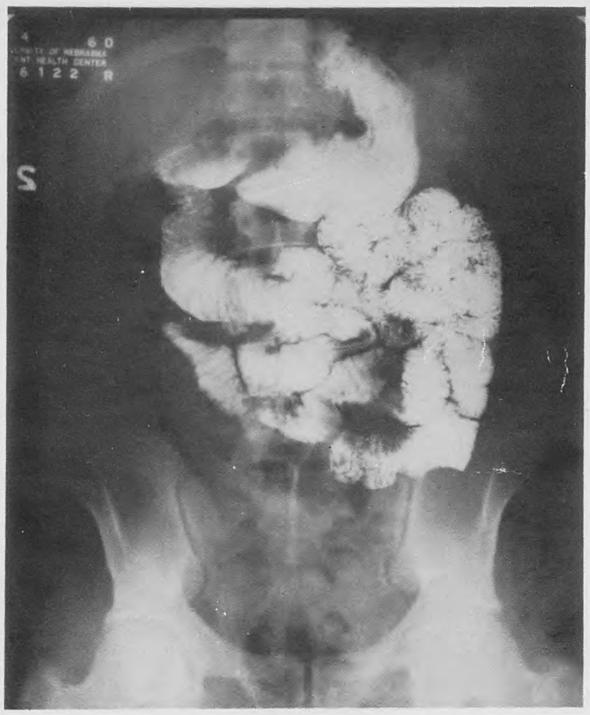

Fig. 4. Two-hour post-prandial film. Patient with "Nervous Stomach."

a twenty-year-old Jamaican student with a "disturbance in motor function of the stomach." In other words, he had a nervous stomach. Note that the barium is still in the stomach and duodenum and only slightly in the jejunum even after 2 hours.

In the spring of this year, four of our football players volunteered to serve as test subjects in an analysis of gastrointestinal motility before and after a football game. The game chosen was the annual Varsity-Alumni Game, one most likely to simulate actual varsity competition. It was our hypothesis that pre-game tension would be sufficient to affect digestion of a pre-game meal. It is the custom, as stated above, to feed our football players a heavy meal consisting of steak (8 oz.), potatoes, vegetables, and so forth at 9:00 to 9:30 a.m. in the hope that it would be digested by game time. This procedure was followed, but with a small glass of barium sulfate added. About 2½ to 3 hours later, just before suiting up for the game, flat film X-rays were taken of their abdomens. These X-rays were then repeated after the game and after the boys had showered, changed clothes, and walked or driven to the Health Service. On the average this was 7 to 7½ hours after eating. By this procedure, it was hoped that some information might be obtained on rate of passage of a pre-game meal.

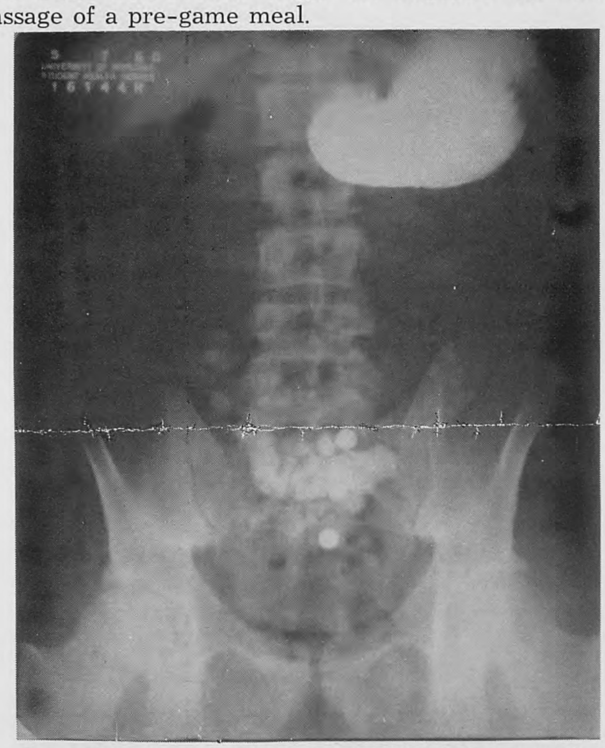

Fig. 5. Two and one-half hour post-prandial. Before-game film.

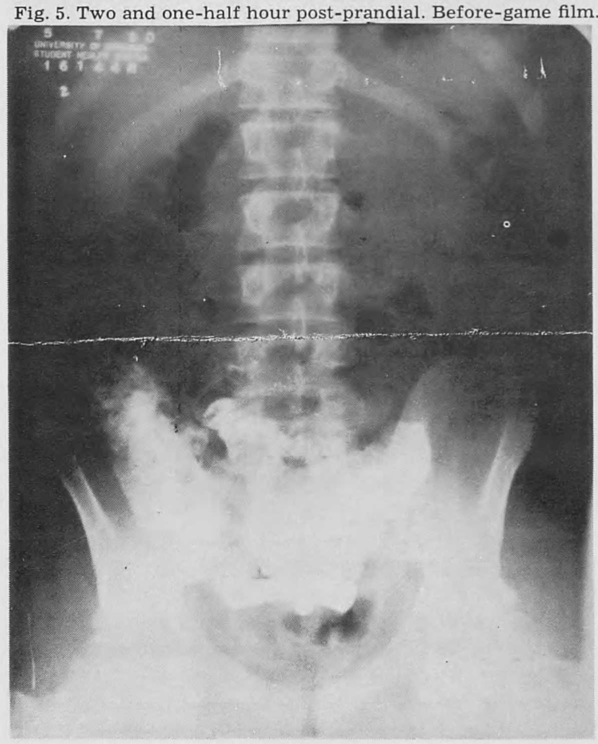

Fig. 6. Six and one-half hour post-prandial. Post-game film.

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PRE-GAME EMOTIONAL (Continued)

The results obtained were surprising but not unexpected.

Only one case has been chosen to demonstrate the delay in gastrointestinal motility brought about by pre-game tension. Figure 5 shows a film taken at 2½ hours after eating. About 90 per cent of his meal is retained within his stomach. After the game, and six hours and forty-five minutes after eating, he still had the meal in his jejunum and it was only just entering the large bowel (figure 6). He was over four hours behind in his digestive schedule. The other three boys retained 25 per cent to 50 per cent of their meals in their stomachs at 2½ to 3 hours after eating, and were from 2 to 3 hours behind on their digestive schedule.

We do not believe that these cases represent physiological variations but rather examples of reduced gastrointestinal motility secondary to pre-game emotional tension. The net result was that these 4 players were simultaneously playing football and digesting a meal.

Assuming, therefore, that these players were digesting while playing, let us examine what effect that might have on their physical and mental aptitude. First and most important is the reminder that it takes blood to digest food. Under normal circumstances, such as after that Thanksgiving meal, one becomes sluggish and lies down "to let his food digest." This is only a manifestation of the fact that the bulk of his blood supply is being pooled in his visceral organs for the purpose of digestion. If one chooses to be physically active after eating, the situation then resolves into a conflict between one's digestive and muscular systems for the available blood pool. I do not know which one wins in any given case, but I strongly suspect both suffer. In muscular activity, glucose, as the energy source, is burned to lactic acid in an oxygen-free environment giving about 0.16 calories per gram. Should this lactic acid accumulate in the muscles, cramps would ensue. This is, in part, what is presumed to occur when a person undertakes too strenuous activity after eating. Our bodies, however, are endowed with a mechanism to prevent this and to obtain more energy. In the presence of oxygen, as furnished by the blood, lactic acid is burned to carbon dioxide and water, releasing 3.8 calories per gram of original glucose. This is twenty-five times the energy released by the oxygen-free mechanism. One can thus see the importance of oxygen in muscular function, i.e., to further oxidize the lactic acid to produce the major part of the needed energy. Since blood is the oxygen transporter in our system, one can immediately recognize the detrimental effect a conflict between digestion and muscular activity would have on physical stamina. Bullen and co-workers stated, in a recent article on Athletics and Nutrition[3], that "Availability of oxygen and its efficient use can become the limiting factor in performance."

Next, we must remember that the mere act of digestion is a complex process. First of all, ingested food must be broken down into molecular-sized particles before it can be transported across the intestinal membrane into the circulation. From there it must be transported to the liver and muscles to be so altered as to be available for use. In other words, one is not sustained at the moment by what is in the process of digestion but what has been stored in the past. Bullen has stated, "In sports which demand endurance and prolonged activity, there is evidence that performance is better maintained if the person

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PRE-GAME EMOTIONAL (Continued)

is on a high carbohydrate diet . . . if these diets have been consumed for several days prior to the event." And again "available evidence indicates that the relative composition or size of the meal preceding an athletic event of short duration is generally unimportant to the performance of the athlete."

It is easy to pose a problem, but less easy to offer a solution. Should you feed or not feed an athlete? If not, as do most track men, how are you going to appease that huge, hungry football player? We believe that there is a satisfactory solution to the problem.

"The degree to which the gastric contents have been reduced to fluid or semi-fluid consistency appears to be an important factor determining the rate of emptying of the stomach." "Solid particles act as mechanical stimuli which, coming into contact with the pylorus, cause pyloric closure" and prevent emptying of the stomach until the food mass is fluid or semifluid. "Fluids and semifluids commence to leave the stomach almost immediately after being swallowed."[2]

Steak and potatoes should be taboo, but there are, on the market, certain protein hydrolysate mixtures with added carbohydrates and vitamins which, when mixed with milk as a milk shake, produce a palatable cold drink containing about 2400 calories per quart. The mixture is liquid, would be expected to leave the stomach at once; it is predigested so that absorption should be rapid; a high caloric intake is concentrated in a relatively small volume; an immediate but not sustained energy source should be readily available; the finished product can be made quite palatable and in a form acceptable to the young adult, namely, as a chocolate milkshake. One should be cautioned that not all protein hydrolysates are palatable. Two, marketed under the trade names of Sustagen and Meritene, are in the acceptable group. In any event, feeding should be early in the day of the game.

Acceptance of such a program of pre-game feeding depends, of course, on the acceptance of the rationale behind it by the coaching and training staff, because they are the ones who must convince the players that this is a basically sound method of preparing them to be in peak physical state when the whistle sounds. We hope that this paper will stimulate some of you to give consideration to the rationality of proper pre-game feeding.

"It is perhaps both a major strength and a dangerous liability to the medical profession that the nature of its mission and the purity of its aspirations have combined to produce, historically, an image of great nobility. The traditional picture of the physician is that of a learned and sacrificial man, who works all hours of the day and night, whose 'prime object . . . is . . . service to humanity', and for whom 'reward or financial gain is a subordinate consideration'. But this ideal physician is an anachronism in an age in which the rest of us work feverishly (but only five days a week and from nine to five) in unabashed pursuit of the 'quick buck'; and in a society where power, glamour and conspicuous consumption seem to make a mockery of humility, modesty, and the life of service." (From an editorial entitled "Reflections on the Image of American Medicine," in New York State J. Med., October, 1960, p. 3217.)

[1] Cecil, R. L., and Loeb, R. F.: A Textbook of Medicine, 10th Ed. (1959), W. B. Saunders Co., Philadelphia, Pa.
[2] Best, D. H., and Taylor, N. B.: The Physiological Basis of Medical Practice, 6th Ed. (1955), The Williams and Wilkins Co., Baltimore, Md.
[3] Bullen, B.; Mayer, J., and Stare, F. J.: Athletes and Nutrition in Sports Injuries, Thomas B. Quigley, Guest Editor, The American Journal of Surgery (1959).

THE EFFECT OF VIGOROUS PHYSICAL ACTIVITY ON THE HEART AND ARTERIES*

By JOSEPH B. WOLFFE, M.D., F.A.C.C., F.A.C.S.M.**

It is a privilege to address you on so timely a subject, one which has important implications for the fitness of our nation. There are no long-range studies published on the effect of vigorous physical activity on the heart and blood vessels. I am, therefore, compelled to base my remarks on personal observations during more than three decades.

It is important to keep in mind that the circulation of the blood through the body is not carried on by the heart alone but together with the vast arterial and venous trees. Our blood vessels play a most active part and, like the heart, constantly contract and relax.

Even if the heart is in good condition, when some of the innumerable vascular channels (i.e. arteries, arterioles, capillaries and veins) are damaged or function poorly, various degrees of circulatory insufficiency may result. Yet, many people think solely of the integrity of the heart when they consider the effects of vigorous physical activity on the circulatory system. More than 80% of our population, past middle life, who suffer for a long time or succumb from what is commonly thought to be heart disease, actually have vascular disease. Because of clot formation, hardening of the arteries or high blood pressure, the heart and kidneys are secondarily affected.

When blood vessels become plugged, their contractile powers fail and/or rupture occurs—then impairment of the part of the body they supply results. Depending upon the site of involvement we speak of a stroke if it strikes the brain; in the eye—impaired vision results; in the heart—muscle damage; in the kidneys—uremic poisoning; in the blood vessels of the lower extremities—intermittent claudication (leg cramps upon walking) or gangrene occurs.

There is however, an optimistic side to the picture. The cardiovascular system has been ingeniously constructed. As in the case of many important highways, there are millions of by-ways running parallel, crosswise and diagonally to the large arteries forming intricately connected nets of blood vessels. Thus all organs and tissues continue to be fed even if an important artery is damaged. This is particularly true of the coronary circulation—the rich blood supply which nourishes the heart. If we inject one of the coronary arteries with an apaque medium, such as iodides or mercury, a web of hundreds of these arteries can be demonstrated on x-ray. The injected material finds its way through the maze of channels into the other major coronary artery.

You should be aware of this rich anastomosis (interconnection) between these vessels. Many people are under the misapprehension that a blood clot or any other obstruction of a coronary vessel—often referred to as coronary thrombosis—invariably maims or kills the individual. This is far from the truth. Recovery takes place as a result of the rich vascular by-ways and life is often sustained to a ripe old age if proper medical treatment is administered and, in many instances, in spite of it.

What is true of the heart is also true of all other tissues. True, but not to the same degree. The life of man and

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lower animals does not depend upon one or even a few isolated arteries. Nature has endowed us with great powers of compensation. If one vessel becomes clogged, others function in its stead by increasing in size and contractility.

EXERCISE AND CARDIOVASCULAR EFFICIENCY

The vascular tree and the heart must be kept in good working order to sustain adequate circulation for everyday life and, particularly, to meet unexpected emotional and physical stresses.

How can this be accomplished? No one knows the answer better than you as trainers, coaches and teachers. You have been instrumental in keeping hundreds and maybe thousands of people in a state of maximum physical fitness. You had thousands of boys and girls under your care who were physically average but by proper training, conditioning and elimination of mental blocks, raised their physical capacity for effort to a marked degree. You are doing it every day. Some of you should be pried loose from pseudo-medical mysticism and rely on your own experiences without fear. A few of you still entertain vague doubts—implanted by misinformation—as to the safety of vigorous physical activities and the harm that may ensue from your methods to attain maximum fitness.

For many years, our team of physicians and research workers at the Valley Forge Heart Hospital and the Wolffe Hospital in Philadelphia, have studied many groups of athletes. Some of them held international records. Among them were marathon runners, swimmers, sprinters, tennis, basketball and baseball players. Among these we could find no evidence of cardiovascular injury as a result of vigorous physical activity. This has also been reported by many other investigators. Yet, in literature, we find reports to the contrary. For instance, experimentalists who studied the effect of vigorous physical activity on dogs and rats reported striking increases in the size of the heart, following such effort. We believe that enlargement of the heart of such exercised experimental animals was due to two important factors:

1. That the animals were not properly conditioned before subjecting them to unaccustomed physical exertion;
2. They were subject to stress reaction by compelling them to continue exercising despite fatigue.

Such compulsion creates fear and emotional stress resulting in enlargement of the suprarenal glands and the heart. This injury may be looked upon as a result of "super fatigue," compulsion or coercion. A scientific coach and trainer will never subject his charges to such excesses.

To verify my impression that vigorous physical activity without compulsion does not cause damage I had a conference with Prof. Chiari of the University of Vienna, one of the world's most prominent pathologists. The University of Vienna has a large Sports Clinic. If damage due to athletics would occur, it would be found in that particular Mecca. Prof. Chiari stated, that in thousands of autopsies performed in his career as pathologist in charge of the Anatomical-Pathological Institute of the University of Vienna, he had never seen normal heart or blood vessels which were damaged by vigorous physical activity. Gentlemen, I am quoting Prof. Chiari to prove that there is no such thing as an "athletic heart" and that normal heart and blood vessels, in the absence of active infection or disease, cannot be damaged by vigorous physical activity, provided a program of gradual conditioning has been carried out.

One may say, "I am not so sure about that. I heard that this coach or trainer knows of a player who died on the athletic field in action." This is true, but unexpected deaths may occur while a person is in bed at rest. We have followed up more than a dozen unexpected deaths which occurred on the athletic field, either personally or by contacting the medical authorities. The majority, both in this country and abroad, were found on autopsy to have had congenital aneurysms of one or more of the arteries forming the circle of Willis at the base of the brain. Death resulted from rupture of such congenital aneurysms. The number of people born with anomaly is infinitesimal. Rupture is more likely to occur during strenuous activity, but may occur at any time. This condition is extremely rare and cannot be diagnosed on routine medical examinations. Only very intricate roentgenologic studies could confirm the suspicion of its existence. Unfortunately, unless a careful autopsy is performed, sudden death of this type of invariably attributed to the heart.

Another small group of individuals who succumbed suddenly during water sports were found to have had a history of minor or major forms of epilepsy. They undoubtedly drowned during a seizure. This possibility must be kept in mind when the heart and blood vessels are found to be normal upon autopsy. Careful inquiry is necessary to obtain a pertinent history from the family. This type of accident is preventable if coaches, trainers or physicians take careful histories. It is hoped that this will be done in the future.

Based upon my own experience of over 35 years in medicine and more than an average interest in athletes, I am still seeking for a single incidence of a proven case of cardiac death—or even damage to a normal cardiovascular system as a result of the most vigorous physical activity.

WHAT ABOUT THE ATHLETE WITH SOME PHYSICAL ABNORMALITY OF THE CARDIOVASCULAR SYSTEM?

Our knowledge of this group is limited and we must, therefore, rely on common sense. We have a great deal of controversial data, but lack longitudinal studies. As yet, nothing but fragmentary observations have been called to our attention. There are many authenticated cases of men and women who had either rheumatic valvular disease or even congenital heart lesion who have outstanding records of performance in various forms of athletics. However, we have no records of their longevity.

Data are needed on longevity and morbidity of young athletes who show an abnormal rise in blood pressure—prior to and during stress, either physical or emotional. It would be logical—from the standpoint of our present state of knowledge—to discourage such individuals from indulging in vigorous physical activity, particularly in inclement weather and rapid changes of altitude. In this category would be those trained at sea level who indulge in the same activity, without proper preparation, at a higher elevation. For example, Mexico City has an altitude of over 7500 feet. An individual accustomed to competitive sports at sea level must undergo a proper training period to adapt himself to body requirements at this higher altitude. Some of these people cannot be stopped from participation in physical activities, but we should compile data of their physical status throughout their

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lives in order to evaluate the effect of vigorous physical activity on this group of individuals.

Another important group for us to consider, though not strictly cardiovascular, comprises individuals in whom varied quantities are albumin are found in the urine following strenuous physical activity. Here, again, our knowledge of longevity and morbidity is meager. But since discretion is the better part of valor, they too, should be discouraged from strenuous participation. However, those who insist on competition should be carefully watched. If the amount of albumin gradually increases over the years, strenuous physical activity should be discontinued.

A third group is composed of those who go through several periods of surmenage. You, ladies and gentlemen, know all about this. You refer to it as overtraining or "going stale." It is a symptom of nervous exhaustion and calls for caution.

BENEFICIAL EFFECTS OF PHYSICAL TRAINING

What, a few years ago, was considered to be the physical limitations of Man, has long been surpassed.

The great physician, sculptor and physical health educator, R. Tait McKenzie, inscribed the following on his famous masterpiece, *The Pole Vaulter:*

> "Nelson Sherrill of the University of Pennsylvania vaulted over a bar thirteen feet in height. May 1923. The world may yet produce an athlete who will soar higher by another foot."

His prediction has not only been exceeded by more than one foot but by more than one athlete. Today, Robert A. Gutowki, the holder of the world's pole-vaulting record, vaulted fifteen feet, eight and one-quarter inches.

What is true of the entire man is also true of his parts. By proper training, heart and blood vessel function can be improved to such an extent that they can meet any body demand even to a degree considered impossible at present.

We have been impressed—in our studies of athletes so far—with the absence of the same degree of hardening of the arteries found in the average population of comparative age, especially in the sedentary segment. Experience teaches us that a swinging hinge rarely rusts. This also applies to man.

Not so long ago, teachers of medicine—myself included —taught students that arteriosclerosis is the result of wear and tear of life. The best example of "wear and tear" of arteries of the lower extremities can be found in marathon runners. They train at least once or twice weekly until they are well past middle life. Yet, our studies of marathon runners failed to show the same degree of atherosclerotic involvement of the vessels of the lower extremities as in the average individual of the same age level.

Another link in the chain of evidence pointing to the importance of physical activity in the well-being of man can be found in the careful study of diabetics. Atherosclerosis and other vascular complications are frequently encountered in diabetes mellitus—a disease due to disturbed carbohydrate metabolism. We have observed diabetics of all ages whose general condition has improved upon systematic physical exercise. Diabetics who participated in some form of vigorous physical activity during their hospital stay required either smaller doses of Insulin, could be controlled by diet alone or were able to reduce oral medication for the control of diabetes. The utilization of sugar through daily exercise helped to lower blood sugar levels, thereby preventing damage to the vessel walls.

Such observations lend scientific credence to an already more widely accepted concept that physical activity is one of the factors in the prevention and/or postponement of degenerative changes affecting the heart and blood vessels.

YOUR PLACE IN PREVENTIVE MEDICINE

From my association with your profession, I have learned to look upon you as teachers in preventive medicine. You must extend your services to the entire population in addition to training the super-fit. To achieve this, some of your workshops and conferences should be held in medical institutions where you can become better acquainted with our problems. Physicans interested in the prevention of disease must, in turn, become acquainted with your technique of training the super-fit. To this end may I urge you to join ranks with the members of the American College of Sports Medicine and other groups such as the american Association for Health, Physical Education and Recreation. Implementation of a program for complete examinations of athletes not only at the height of their physical activity but through the athlete's life span would be of real value. Besides a thorough physical examination such a study should include x-ray of the heart, electro-cardiogram, condition of blood vessels, blood cholesterol, blood count and urinalysis.

Such records would be invaluable as a guide for the type, degree and length of exercise indicated to achieve maximum fitness throughout life.

You are charged with selecting and improving the super-fit as an example for emulation; raise the standard for the average and rehabilitate the underfit.

It is important that you work as closely as possible with the medical profession to keep our population in a state of maximum health.

LET'S GO TO MADISON IN JUNE

Seems as if wherever you turn in Madison there's pleasant water—to look at, or swim in, or fish from, or glide over in a boat.