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CONSERVATIVE MANAGEMENT OF DIABETIC FOOT COMPLICATIONS

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Improved management of diabetes has resulted in an increased average life span. As diabetics succeed in living with their disease for twenty or more years, an increasing number develop a severe degree of atherosclerosis. This is in part a result of survival into the age group in which atherosclerosis is present in the non-diabetic and in part due to the known tendency for longstanding diabetics to develop arteriosclerosis.

Atherosclerosis of the lower extremities has increased the incidence of diabetic foot complications including gangrene and infections. As experience accumulates in handling these complications, it is found that lesions which at first sight seem hopeless can often be treated conservatively without surgical amputation. Even before the introduction of sulfonamides and antibiotics, self-amputation of gangrenous digits could be accomplished and extensive infection of the foot could often be controlled after adequate incision and drainage. Antibiotics have removed the risk of conservative management and served to control most foot infections. We feel that most cases should be given at least a trial of conservative therapy. In a few cases, amputation will later be necessary because of intractable pain, extensive tissue destruction, or too great loss of skin. In favorable cases, at least a part of a foot will be preserved for the patient to walk on. Not only will the patient be spared the psychic trauma of losing an extremity, but the preservation of the natural foot will preclude the increased strain on the other foot, which is certain to result from ambulation with crutches or an artificial leg. It must be remembered that if the lesion is caused by arteriosclerosis, arteries in the sound leg may be involved to an equal degree and greatly increase the hazards of trifling injuries to the remaining foot. For this reason, amputation of the first foot should be avoided as long as possible in the arteriosclerotic patient. Bilaterally deficient circulation renders ambulation with an artificial limb a much more hazardous undertaking than it would be in a younger individual whose foot might be amputated for a crush injury and whose remaining foot had normal arterial circulation.

Prevention of Foot Complications

Most foot lesions are preventable and have their origin in minor injuries which could have been forestalled if the patient had been aware of the hazards and had used care to avoid them.

Good diabetic control is an important preventive measure. Patients should be warned that poor control favors infection, disturbed lipoprotein metabolism,

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atherosclerosis and neuritis.

With the onset of claudication, leg cramps and cold feet, the patient should be made aware of the impaired circulation and proper foot hygiene should be re-emphasized. Patients are frequently unaware of impaired pain and temperature sensation, and are thus deprived of this important protection against various forms of trauma, heat, cold and chemical agents. Loss of pain sense may allow a noxious agent to remain in contact long enough to produce necrosis of tissue. It is for this reason that hot water bottles and self-surgery should be forbidden.

Diabetics should be told to take care to keep the skin of their feet intact. This is particularly true where the skin has become thin, inelastic and deprived of its fatty subcutaneous cushion, as a result of impaired circulation. A daily foot bath is recommended, avoiding excessive use of soap to preserve natural oil. Dryness and cracking can be avoided by oiling the skin with lanolin, baby oil containing lanolin, or petrolatum.

Patients should be warned of the dangers in the use of all forms of heat, ordinary skin antiseptics, home remedies and salves. The combined analgesic and necrosing properties of phenol render its use, even when diluted, especially hazardous and its use without medical supervision has directly resulted in loss of an extremity. Tincture of iodine is too harmful to tissues for use in the diabetic foot. Seventy percent alcohol has been satisfactory for use as an antiseptic in the home and our patients are advised to use nothing else without the permission of the doctor.

Hot water bottles, chemical heat bottles and electric pads are not to be used because of the burn hazard if pain and temperature sense is impaired.

It is our feeling that all foot care, beyond the ordinary daily hygiene, should be in the hands of a trained person. The diabetic person should not do any cutting or peeling of skin. Patients are encouraged to report at once to their doctor if anything unusual about their feet occurs. The use of adhesive tape has resulted in skin injury when the skin is thin and atrophic. The superficial layer of skin can easily be pulled away with the tape as it is removed, resulting in an ulcer. If adhesive tape is to be used, it should be applied to the outside of the dressing, or only to healthy skin.

Socks should be of ample size, both as to the length and width, to avoid binding the toes together. Socks preferably should provide a slight cushioning effect against the sole and upper of the shoe and allow air circulation.

Shoes should provide a full half inch space beyond the great toe and be wide enough to allow all toes to be moved. A last should be selected which allows the first toe to be in line with its metacarpal without pressure of the shoe corner on the great toe-nail. The lining should be smooth, free from projecting seams and hard ridges. No lining is better than a torn cloth lining. The inside of the shoe should be examined frequently with the hands to detect foreign bodies and nail points which can injure the neuritic foot repeatedly without the patient becoming aware. Soft leather has the advantage of not traumatizing the skin, but the disadvantage of exposing the toes to injury by falling objects. Hard metal toes (with ample

room) are needed where metal and heavy objects are handled. New shoes, even if they fulfill the above requirements, should never be worn more than an hour or two for the first few days. After shoes have been broken in, daily pressure on the same area can be avoided by wearing different shoes on alternate days. The patient should not walk without the protection of shoes or slippers.

The nails should be trimmed straight across, the corner thus produced may be rounded slightly, but should be outside the skin fold. If the shoes are ample in size, nothing further is needed to prevent ingrown nails. It is best that nail trimming not be done by the patient, because he must cut from an awkward position; he may cut too deep because of neuritis or impaired vision.

Corns usually result from ill-fitting shoes. They can be prevented or relieved by proper fitting shoes. They should never be trimmed by the patient or other untrained person. First, the pressure should be relieved by allowing sufficient room in the shoe. The corn may be softened by alternate soaks in water and oil applications. With the pressure relieved, the softened corn will gradually be extruded. The top of the corn may be cut off gradually, as it lifts itself out. This is best performed by a physician, nurse who understands the problem, or a co-operative chiropodist.

Callus is also a result of continuous pressure, usually to a larger area than with a corn and usually on the sole of the foot. Where callus results from disturbed foot mechanics, the orthopedist may help. Excessive pressure on the callus may be relieved by using a sponge rubber ring in the shoe (1). Calluses can be removed by relieving the heavy pressure and by advising patient to oil with lanolin, baby oil or petrolatum. After softening, the callus can gradually be pared down, if



Fig. 1—After adequate wide incision.



Fig. 2—Healed after 3½ months, showing skin graft.

necessary. The callus with its ischemic underlying tissue is a frequent site of chronic infection and deep ulcer. Healing of the ulcer cannot be accomplished until the surrounding rim of callus has been pared down by a surgeon. This operation can be facilitated by rest in bed and softening of the callus by soaking. This type of plantar ulcer is a constant invitation to organisms capable of producing cellulitis of the foot.

Another point of entrance for micro-organisms is the fissure between the toes. This may result from a fungus infection or simply from excessive moisture. Shoes which are wide enough to allow air circulation between the toes will reduce perspiration and the susceptibility to fungus infection. The skin between the toes should be thoroughly dried. Propionic acid dusting powder ("Desenex") daily will combat moisture and act as a safe fungicide. Strong fungicides should be avoided.

EVALUATION:

Clinical examination alone frequently leads to an adequate evaluation of the circulation in the affected foot. On attempting to assess the prognosis of a foot complication, one must consider the patient as a whole, the degree of symptoms, the condition of the arteries generally and locally. Specific laboratory procedures may add further information. Certainly the future cannot be told by just a single cursory look at an extremity. Our plan of evaluation is given in Table I.

TABLE I. Evaluation

- I. Walking capacity, degree of symptoms
- II. Careful clinical examination
 - A. Palpation of vessel walls and pulses
 - B. Condition of skin and subcutaneous tissues
 - C. Relative color, warmth
- III. Results of conservative regime
- IV. Other available tests
 - A. Occlusion index
 - B. Sympathetic blocks
 - C. Arteriography

In the last analysis, the truest evaluation results from a trial of conservative therapy. We have seen many patients who had been advised to have a leg amputation respond to conservative therapy to a degree that a major amputation has been obviated.

Although atherosclerosis in diabetics is usually a diffuse process, Leriche's (1) syndrome of sclerosis of the aortic bifurcation should be considered in diabetics as well as non-diabetics when a deficient circulation occurs in the feet. Aortography has become a very useful adjunct to the evaluation of the condition of the vessels. When the sclerosis is localized, in a large artery, resection followed by a homograft offers hope of restoring circulation to the foot.

MANAGEMENT OF DIABETIC GANGRENE

Gangrene which continues to progress into the foot and which produces local and systemic symptoms while under conservative supportive therapy is best

handled by surgical intervention. Conservative management should be tried in cases where the gangrene is limited to a digit or digits.

The management of diabetic gangrene is listed in the following table:

TABLE II. Management

- I. Diabetic control
- II. General health
- III. Protection against physical and chemical injury
- IV. Antibiotics
- V. Vasodilators
- VI. Anticoagulants
- VII. Consider sympathectomy

The diabetic patient with gangrene of the foot should be put at rest. The diabetes is meticulously controlled. This means the fasting blood sugar should be between 100-150 milligrams percent; and the twenty-four hour urine should contain no glucose or less than 15-20 gms. If the patient is anemic, the condition is best corrected by transfusion. The individual who is anemic and in negative nitrogen balance resists infection poorly and heals slowly. If there is no azotemia, a good protein intake is given. Testosterone may be of value in helping put the patient in a positive nitrogen balance. If there is neuropathy associated with the gangrene, and there usually is some, parenteral vitamin B and B-12 are given.

The positioning of the patient and limb in bed is important. It is a common practice to elevate the feet, particularly if there is edema. This is probably of value in disease of the veins, but since this decreases the already short blood supply of the feet, we see that a level position is maintained with the patient comfortable. The foot is left exposed to the air and the leg is protected by a cradle which must be well padded so as to avoid further injury to the limb if the patient should happen to bump it. The foot and leg are moved by the patient frequently to prevent the development of pressure areas where the foot rests on the bed. Physio-therapy is used to keep the joints motile and aid muscle tone in the rest of the leg and body. Heat is not applied as it would increase the metabolism of the cells, thus requiring more blood which is not available.

If infection is present, antibiotics are started. By reducing the infection and swelling there may be enough improvement of the blood supply to keep the gangrenous process to a minimum. Before the day of antibiotics, the infection and swelling would cut down the blood supply and the gangrene would advance rapidly up the foot and leg.

Gangrene advances by thrombosis. When the lesion seems to be progressive and there is considerable pain, a ten to fourteen day course of heparin is started. The heparin seems to help control the pain as well as prevent advancing of the gangrene. Heparin is given intravenously 75 mg. five times per day. With this dosage there has been very little trouble with bleeding.

Engelberg and Massell (2) have used heparin in peripheral vascular disease with some benefit in walking tolerance. Waldow et al (3) have shown that heparin had a lowering effect on lipemia in normal subjects, and there was also a reduction

of the gamma globulin concentration. This suggests that a heparin-globulin reaction may be related in the clearing of lipemia.

Drug therapy is somewhat limited in cases of gangrene of the foot. There are two types of medication in use. One type tends to increase the blood flow. Among these are aminophylline, priscoline, nicotinic acid and papaverine. If some spasm is present they may be of value. The other type of drug used is one which controls pain. It is best to avoid narcotics; salicylates given at regular intervals with sedation control most of the pain. Dry gangrene is usually painless. Alcohol by mouth may be tried for its sedative and vasodilating effect.

If there is a marked degree of vaso-spasm determined by the different tests, a sympathectomy should be considered. Because the tests are not always conclusive, preliminary paravertebral block may be tried. If the foot temperature is increased, a sympathectomy is indicated. The sympathectomy, of course, will not cause a reversal of the gangrenous process, but rather keeps it from progressing and it does warm the leg and foot so that they will be more comfortable.

A case report shows the favorable outcome where amputation was previously advised: A 62-year-old female who had had diabetes for fifteen years was admitted to Henry Ford Hospital in December, 1951, for gangrene of the right foot. She gave the history of stepping on a toy block three weeks before. One week previously a larger blister appeared on the plantar surface of the foot. The blister broke and bloody pus was discharged.

The examination at this time showed an obese female with a gangrenous ulcer on the right foot. There was evidence of swelling and inflammation. The admitting temperature was 103, hemoglobin 9.7, W.B.C. 18,200 and blood sugar 154.

The patient was placed on penicillin, given blood—and a surgical debridement. On the seventh hospital day, the foot was opened widely. For thirty days saline soaks were used, alternating with streptodornase and streptokinase. After thirty days the wound had cleared and healthy granulation tissue was present. Three months after admission, the area was debrided and a dermatome skin graft was done. After three and one-half months of hospitalization, the foot had healed and the patient walked out of the hospital without crutches and with a usable foot.

CONSERVATIVE SURGICAL PRINCIPLES

The decision to do a leg amputation has in the past frequently been decided upon without a real attempt to determine what can be accomplished by a lesser procedure. Certainly it is unwise to waste time and money in pursuing a conservative course in the face of insurmountable odds, for in such instances an above-knee amputation will result in rehabilitation in the shortest possible time.

Injudicious mechanical instrumentation in the local care of open foot lesions may do a great deal of harm. An active thrombosis may be precipitated in adjoining healthy tissue by attempts to separate dead tissue before the proper time. The instinctive desire to do something extensive must be curbed and only inspection and very gentle palpation with light pressure used during examinations.

The low vitality of the tissues must be always kept in mind. Tourniquets and clamps are always to be avoided and the finest concepts of plastic surgery adhered to (4).

With the conservatism permitted by the use of antibiotics, the performance of conservative foot amputations has been repopularized. Here, as in repairs after trauma, as much viable tissue as possible should be saved. As much of the metatarsals as possible should be saved, as any additional length improves the walking ability.

All pertinent phases of a patient's life and physical condition must be explored to determine the best method of treatment. The financial position of a patient and his family, his capacity for work, his ability to use a prosthesis, the degree to which he will adhere to a medical program and advice, and the condition of the opposite extremity are to be considered.

The results of a conservative attitude with the employment of all measures short of amputation have in our hands given very encouraging results in borderline cases. Antibiotics by controlling infection have removed the urgency of amputation. The principles of conservative therapy are given in Table III:

TABLE III
Conservative Surgical Principles

- I. Adequate incisions for infection
- II. Antibiotics
- III. Trial of conservative management
- IV. Debridement
- V. Local amputation
- VI. No tourniquet or tight dressing

CONCLUSIONS

1. The conservative management of diabetic foot complications gives surprisingly good results. Many patients respond to a conservative program, where major amputations were earlier considered necessary.
2. The avoidance of trauma of every type, including injudicious probing and handling, is of the greatest importance if success is to be obtained.
3. A careful program of management is essential.

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