General Principles of Proximal Amputations of the Lower Limb

B Y Low

Department of Orthopaedic Surgery
Changi General Hospital
Singapore

INTRODUCTION

Amputation is the most ancient of all surgical procedures. Amputation of a hand or a foot was a common punishment in many societies in the past.

Early surgical amputation was a crude procedure by which a limb was rapidly severed from an unanaesthetized patient.

Haemostasis of the open wound was often done by pouring boiling oil over it. Ambroise Pare, a French military surgeon, was the first to use ligatures for haemostasis and creating a more functional stump in early sixteenth century.

Incidence of Amputation

About 30,000 amputations are carried out in USA per year. In Singapore, it is about 1-2 proximal amputations of the lower limb per day. This is mainly due to aging population with a high incidence of diabetes and peripheral vascular disease (PVD).

About 75% of all new amputees are men – as the underlying causes are more common in men.

Pathophysiology of Diabetic Foot

Bauting, an orthopaedic surgeon and Best, a medical student, isolated insulin in 1921. The subsequent injectable animal extracts were heralded as a cure for diabetes mellitus. Unfortunately, the use of insulin has not lived up to this bright prediction.

Since the pathophysiology of diabetes cannot be reversed, treatment of diabetic foot is directed at symptoms, laboratory findings and secondary manifestations. This leads to multifaceted approach with many specialties involved. The team approach is superior. They include endocrinologist, orthopaedic surgeon, radiologist, vascular surgeon, etc. Paramedical personnel include nurses, pedorthrist, social worker and occupational therapist. Surgery of the diabetic foot is most often ablative, sometimes reconstructive (especially vascular surgery) and occasionally prophylactic. The progression of pathophysiological changes is caused by peripheral neuropathy, infection ischaemia, or a combination of the three. Peripheral neuropathy is present in most diabetes and has been found in all who have had the disease for more than 20 years. There is no known treatment except palliation.

Neurogenic bone changes can range from mild osteopaenia to severe arthropathy (Charcot's joint). Destruction of the bony architecture could lead to point pressure in the foot and eventual ulcer formation.

Infection of the diabetic foot is more frequent than the normal population. Many factors appear to affect the outcome. The function of diabetic white cells has been shown to be impaired.

Basement membrane thickening may interfere with vessel's wall transfer of nutrients and humeral factors. Increased glucose content of the blood and tissue may offer better culture media for bacteria.

The autosympathectomy of diabetic neuropathy may decrease the normal vascular response to infection.

The ischaemic lesion in the diabetic foot is partly due to large and medium artherosclerosis. Purely arteriosclerotic lesions usually occur after age of 50 and most often seen in vessels distal to the knee. The evaluation and treatment of PVD in diabetic and non-diabetic are similar.

Grading of Diabetic Foot Lesions

Lesions of the diabetic foot are divided into 6 grades, depending on the depth of the wound, presence of abscess or osteomyelitis , and the extent of gangrene.

Grade 0 : (a) skin intact
(b) multiple callosities
(c) deformities of foot
(d) Charcot's arthropathy

Grade 1 : (a) open skin lesion
(b) base is clean
(c) may have deformities of foot

Grade 2 : (a) open skin lesion
(b) extent to bone and tendon
(c) base may be infected

Grade 3 : (a) osteomyelitis
(b) septic arthritis
(c) gross destruction of soft tissue and skin

Grade 4 : (a) gangrene of toe or toes
(b) gangrene of forefoot

Grade 5 : (a) extensive gangrene including hindfoot
(b) salvage of foot not possible
(c) at least below knee amputation is required

Grading of diabetic foot lesions is useful in the guide of treatment, prognosis and measurement of outcome.

Indication for Proximal Amputations of the Lower Limb in Diabetes

Irreparable loss of blood supply of a diseased limb is the only absolute indication for amputation. This is the most common problem in PVD and diabetes.

A part cannot survive when its nutrition is destroyed. It then becomes not only useless but a menace to life because the toxic products of tissue destruction are spread throughout the body.

Gangrene of a limb caused by arteriosclerosis is usually more difficult to treat in the presence of diabetes because the tissue healed poorly and are more susceptible to infections.

Furthermore, diabetic neuropathy even when sub-clinical, can cause delayed healing when diminished sensation results are repeated by unnoticed trauma.

Arteriosclerosis and diabetes are systemic disease, and this fact should be considered when amputations are necessary in this disease.

During the past few years, it had been shown repeatedly that after amputations are carried out through the lower extremity for PVD and diabetes, the stump will usually heal if the blood supply to the tissue is adequate.

However, infection must be adequately controlled and the surgical technique must be meticulous and the management after surgery must be proper.

Infection

Infection, either acute or chronic that is unresponsive to medical for surgical measures may be an indication for amputation. Of the infections requiring amputations, fulminating gas gangrene is the most dangerous and usually demands immediate amputation. This may also happen in gas forming organism afflicting the lower limbs in diabetes such as necrotizing fasciitis.

The amputation is usually proximal to the level of infection. Hyperbaric oxygen therapy, when available, sometimes eliminate the need of amputation or make amputation possible at a main distal level.

The indications of amputation on a chronically infected limb are usually less defined. Occasionally the ill effects of chronic infection on the body as a whole may justify amputation.

Nerve Injuries

The usual indication for amputation after nerve injuries is the development of trophic ulcers in an anaesthetic limb. This can happen in diabetic due to peripheral neuropathy.

A trophic ulcer in a foot often becomes infected resulting in much tissue destruction.

Surgical Principles of Amputation

The basic principles of surgery are as important in amputations as in any other operation and should be followed precisely with meticulous attention to details and gentle handling of tissues.

Tourniquet

This should be avoided if possible, especially if patient had PVD.

Level of Amputations

In the past, amputation through the specific levels was necessary for proper fitting of prosthesis. With modern total contact sockets and sophisticated prosthetic fitting techniques however, the level of amputation is less important.

Rather, any well-healed, non-tender, properly constructed amputation stump can now be satisfactorily fitted with a prosthesis. Therefore the level of amputation is determined primarily by surgical considerations.

Skin Flaps

Regardless of the level of amputation, covering the stump with good skin is most important. The skin at the end of the stump should be mobile and normally sensitive. With modern prosthetic fitting and with total contact sockets, the location of the scar is rarely important. But the scar should not be adherent to the underlying bone because of an adherent scar makes prosthetic fitting difficult and this type of scar often breaks down after prolonged use.

Muscles

In myoplastic amputation, the muscle should be divided at least 5 cm distal to the level of the intended bone section. They should then be returned to the bone or to opposing muscle groups under appropriate tension and then trimmed to a suitable length.

Proponents of myoplasty believed that these techniques improve the function of the muscles and the circulation in the stump and help prevent phantom pain. But it should be pointed out that myslastic flap should be carefully used in PVD.

Blood Vessels and Nerves

All major vessels should be isolated individually ligated with non-absorbable sutures before being divided. The larger ones should be doubly ligated.

The nerves should be gently pulled distally in the ward and cleanly ligated and divided, so that it can be retracted into the stump. This will avoid post-operative pain and neuroma.

Bone

Excessive periodic stripping is avoided. This is to prevent ring vascular necrosis ad sequestra.

Bony prominent not so well padded by soft tissue should always be resected and the end smoothened by rasp.

Conclusion

Diabetic foot is a complex problem. It encompasses vascular, infection, biomechanic and many other social and economic issues. A proper understanding of its pathophysillogy will help in the management of this condition.

Many amputees will become a burden to themselves, families and societies. If they are not properly counseled and rehabilitation, will end up in asylum and welfare homes.

REFERENCES

1. Evarts. Surgery of the Musculo-Skeletal System, 1983.
2. Campbell Operative Orthopaedics, 9th Edition, 1998.