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Original Research Article

Reamputation rates, morbidity and rehabilitation after lower limb amputations

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ABSTRACT

Background: This study attempted to document the indications for lower limb amputation (LLA) and its outcomes especially the wound healing problems, reamputations and subsequent use of prosthesis for mobilization in Indian population.
Methods: This observational study included 92 patients over a period of 18 months. Indications, level of LLA, morbidity and reamputation rates after LLA were recorded. Stump status, wound healing and other morbidity was followed over period of one month. The use of prosthesis and level of mobility were assessing in follow-up over a period of six months.
Results: There were total 109 LLA in 92 patients as some of these patients had to undergo revision of amputation stump at a higher level. Atherosclerosis (29.3%) was the main cause for LLA. Age group 35-55 years and male patients were most commonly needed LLA. Total 64.13% patients developed post-operative wound infection and 18.4% patients underwent reamputation. *E. coli* and *Staphylococcus* were the most common organism cultured from the infected surgical site. Conversion of below knee amputation (BKA) to above knee amputation (AKA) was the most frequent reamputation and atherosclerosis was the leading cause. According to final level LLA, 54 had major amputations (above ankle joint), only 37% were using a prosthesis whereas majority of patients were dependent on crutches/walker.
Conclusions: Patients of atherosclerosis and trauma had a higher frequency of reamputations. Only 37% of major LLA opted for prosthesis whereas majority of patients mobilize by other means like crutches or walker.

Keywords: Lower limb amputation, Below knee amputation, Above knee amputation

INTRODUCTION

Amputation of lower limb is a fairly common procedure undertaken by general surgeons. Amputations are associated with intense social, psychological and economic impact on the patient as well as the family. Amputation is conducted if all else fails when rescue of extremity is inconceivable or when the extremity is dead or dying and endangering the patient's life. Patients in developing nations present late when limb salvage is not an option, otherwise amputations are largely preventable.

An increase in the number of LLA done in patients of peripheral arterial disease has been noticed. In developed nations peripheral arterial disease is a leading cause for lower limb amputation while amputation due to infection, trauma, uncontrolled diabetes and tumours are the main source for amputation in developing nations.[1]

An amputation of limb is a mangling procedure and a major public health problem.[2] It is a surgical choice where the salvage of limb is difficult and the diseased part of the limb require excision.[3] Amputation of limb is a

standout amongst the most antiquated of surgical treatments, its history dating back as far as the 16th century. Amputation has been conducted throughout ages for diverse reason such as punishment, atonements, customs and sometimes as a treatment. It retains relevance in modern times. Limb amputation was considered as a major surgical procedure fraught with high risk until the invention and implementation of general anaesthesia took place and speedy technique was crucial. Many patients succumbed to haemorrhagic and septic shock following amputation and to deal with such complications surgeons depended on speed and technique to improve results and minimize pain.[4]

Amputation can be major (above the ankle joint) or minor (below the ankle joint). For the evaluation of the level of amputation it is important to consider the severity and pattern of vascular illness, the level of tissue damage and the viability of tissues in the region of the flap proposed. Among minor amputation, amputation of toe is most common and it is conducted using circular or fishmouth incisions. This procedure is performed through proximal phalanx and it is not done through joint as it results into cartilage exposure which is avascular leading into non-healing of wound. Toe removal through the metatarsal bone is described as ray amputation. The head of metatarsal is opened through incision known as tennis racquet-shaped and it is excised at the neck. Remnants of tendons are excised. In case of infective wound it is left open. Ray amputation usually permits regular mobilization, but ray amputation of the hallux may result in skin ulceration of planter aspect due to irregular weight bearing.

In case of infection or gangrene affecting several toes, transmetatarsal amputation is indicated. The incision uses a total plantar flap therefore the plantar skin must be healthy. The metatarsals are divided at the mid-shaft level. Excellent function remains in transmetatarsal amputation if wound is not infected and heals well. For proximal disease of forefoot, mid-foot amputation may be done without undergoing transmetatarsal amputation. In case of absent or correctable ischaemia, this amputation should be considered. Disarticulation of talonavicular and calcaneocuboid joints is known as Chopart amputation whereas disarticulation between tarsal and metatarsal bones is labeled as Lisfranc amputation. Healing rates are uncertain and equinus deformity may develop leading to limited ambulation. The Syme and Pirogoff amputations are indicated near the ankle joint. Fitting of prosthesis is troublesome and mostly below knee amputation is preferred to permit desirable ambulation and healing.

For transtibial amputation, two techniques are usually used. In the Burgess long posterior flap technique, 14 cm distal to the knee joint or 10–12 cm distal to the tibial tuberosity incision is given. For efficacious limb fitting below the joint line, minimum 7 cm of stump is needed. Above the skin incision, the periosteum of fibula bone is stripped off up to 2 cm and it is divided and smoothened. Stripping of tibia periosteum is done till the level of proposed division and the bone divided with the help of oscillating saw. To cover tibial bone end, gastrocnemius muscle is appropriately thinned to provide coverage and soleus muscle is excluded from the posterior flap. Skew flap amputation is another technique used when long posterior flap is not feasible because of gangrene or ulcer. This technique provides cylindrical shaped stump in comparison with posterior flap technique as it avoids the need for long postoperative stump molding before fitting of prosthesis.

Following above-knee amputation, the aim should be to attain a stump sufficiently long so that it act as a lever arm for the fitted prosthesis and to provide good ambulation. A bone segment 25 cm below the greater trochanter or 15 cm above the tibial tuberosity is most favorable. 15 cm is shortest stump recommended from the greater trochanter.

Some of the indications for hip disarticulation are malignant tumor, crush injury, massive trauma, infection or gangrene and a previous non-healed above-knee amputation. Following this surgery the rate of ambulation is reported very low.

The need for LLA has been linked to lots of factors such as the age, presence of peripheral arterial disease, uncontrolled diabetes, smoking habits and the availability of health care services. The care of such patients after amputation is complex because of the poor general condition and presence of co-morbidities. The surgery has a high risk of wound infection and wound necrosis requiring re-amputations. To prevent limb loss it is important to recognize patients who are vulnerable to develop gangrene or infection and provide optimal and timely management, before a need for amputation arises. The study was planned to assess the burden of lower limb amputation with respect to underlying cause and level of amputation and to study the demographic profile, clinical presentation and surgical outcome of patients undergoing lower limb amputations.

METHODS

The study includes patients from the Department of General Surgery, Plastic Surgery and Orthopedics Himalayan Institute of Medical Sciences (HIMS), Swami Ram Nagar, Dehradun, over a period of November-2016 to April-2018. Subjects were recruited from patients undergoing lower limb amputation in respective department OT, HIMS, Dehradun after obtaining written informed consent. Ethical clearance was obtained from Ethics Committee.

Study design

Type of the study: Observational study.

Sample size and sampling methods: Convenience sampling was done and 92 patients were included in this study.

Selection of subject

Inclusion criteria

Inclusion criteria were adult patients admitted in hospital undergoing lower limb amputation.

Exclusion criteria

Exclusion criteria were minor lower limb amputations done on OPD basis.

Study tools

In all cases case reporting form is used.

Study protocol

All the significant clinical points of interest of history and physical examinations were recorded in particularly designed case reporting form.

Detailed clinical history: A careful history was taken considering the followings.

- Reasons of LLA and factors leading to complication like vascular insufficiency, diabetes mellitus, tumors, injury and smoking;
- Amputation level;
- Hospital stay;
- Complications: wound problems (infection, wound dehiscence, poor stump shape), chances of reamputation, phantom pain & sensations (Patients frequently remark that they can feel the amputated limb i.e. phantom limb and sometimes remark that it is painful i.e. phantom pain) and stump pain;
- Stump and skin care;
- Outcome of wound over a period of 1 month was followed-up;
- At the 3 month follow-up the use of prosthesis and the level of mobility achieved by the patient was noted.

Statistical analysis

All data were entered in a excel sheet utilizing SPSS Interpretation and simple statistical tools were used such as mean and percentages.

RESULTS

There were 92 (n=92) patients who underwent a total of 109 amputations of the lower limb as some of these patients had to undergo revision of amputation stump or repeat amputation at a higher level. The age of the patients ranged between 16 to 80 years, with a mean age of 55.4 years. Atherosclerosis (29.3%) and diabetic foot (28.2%) were the main cause of LLA (Table 1).

Table 1: Mean age distribution according to disease etiology in patients undergoing lower limb amputation (n=92).

Etiology	Mean age (in years)
Atherosclerosis	57.8
Buerger's disease	37.4
Diabetic foot	59.8
Infection	60
Trauma	53.6
Carcinoma	49.7

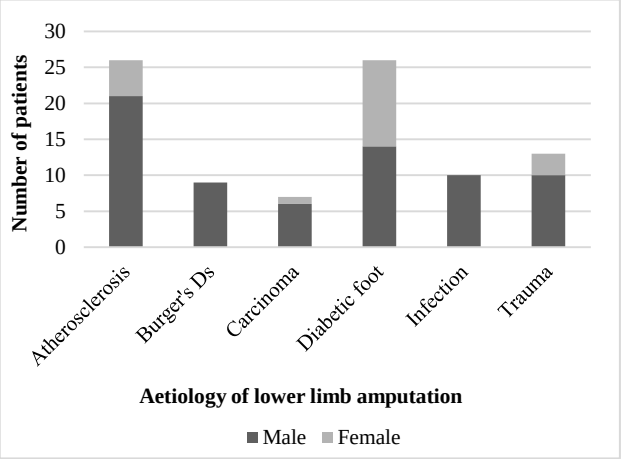

Figure 1: Gender distribution according to disease aetiology in patients underlying lower limb amputations (n=92).

Across all the aetiologies, a male preponderance was seen except in the patient with diabetic foot. Here there were a nearly equal number of males and females (Figure 1).

Amputation due to trauma (road traffic accident) was the third most common cause of LLA (Table 2).

Table 2 also depicts the level of amputations in 92 patients.

Out of 109 amputations, there were 70 major lower limb amputations (above the ankle joint) and 39 were minor amputations. Patients of atherosclerosis and trauma had higher percentage of major lower limb amputations (88.8% and 92.3% respectively) whereas minor amputations were more common in diabetic foot patients (69.2%).

In the present study out of 27 patients of atherosclerosis, 6 patients underwent revascularization prior to the final decision of amputation.

Table 2: Distribution of lower limb amputations based on etiology (n=92).

Diagnosis	No. of patients (%)	No. of amputations			
		AKA	BKA	Minor	Total
Atherosclerosis	27 (29.3)	7	17	12	36
Buerger's Ds	9 (9.7)	1	5	4	10
Diabetic foot	26 (28.2)	3	8	18	29
Carcinoma	7 (7.6)	4	3	0	7
Infection	10 (10.8)	4	3	4	11
Trauma	13 (14.1)	8	7	1	16
Total	92	27	43	39	109*

*The total no. of amputation is more than the no. of patients as some patients had repeat amputations at higher level.

Table 3: The level of reamputations and distribution according to aetiology.

Reamputation	Toe to forefoot	Toe to BKA	Forefoot to BKA	BKA to AKA	Below knee to disarticulation at knee joint	Disarticulation of knee joint to above knee	AKA to Disarticulation of hip joint
Atherosclerosis	0	1	4	4	0	0	0
Buerger's Ds	0	1	0	0	0	0	0
Diabetic foot	1	0	0	2	0	0	0
Infection	0	0	0	0	0	0	1
Trauma	0	0	0	0	2	1	0
Carcinoma	0	0	0	0	0	0	0

There were 17 patients who underwent reamputation (Table 3). Re-amputation was done mostly in patients of atherosclerosis with peripheral arterial disease (34.6%) and in trauma patients (23.07%) where major amputations had been undertaken. The most common cause of re-amputation was post-op wound infections leading to non-healing of amputation stump.

Total 59 patients (64.13%) developed post-operative wound infection. Patients who underwent amputation due to infectious disease for example necrotizing soft tissue infection and osteomyelitis and diabetic foot had a very high rate of post-operative wound sepsis (90% and 76.9% respectively).

Table 4: Mortality in patients who underwent LLA (n=92).

Mortality	No. of cases
Atherosclerosis	3
Buerger's disease	1
Carcinoma	0
Diabetic foot	1
Infection	2
Trauma	0
Total	7

Out of 59 patients who develop post-operative wound infection, 19 patients (32.2%) had poly-microbial infection and the most common organism isolated was *Escherichia coli*. There were 7 deaths in the study group, out of which one patient of atherosclerosis died due to Myocardial Infarction on post-op day 11, rest all patients died due to persistent sepsis with multiple organ dysfunction syndrome (Table 4). Despite amputation, all of the patient had progressive sepsis due to stump infection or the multi-organ dysfunction lead to mortality despite source control of sepsis (i.e. amputation of infected part).

Out of 92 patients, 54 had major amputations (according to final level of amputation). Among these, only 20 patients were using for prosthesis for mobilization. 27 patients used crutches and 8 patients used walker. Overall 52.17% patients were able to follow previous occupation and were moving out of house and the rest were confined to home or room.

DISCUSSION

An interesting pattern is seen with regard to age and gender of the population undergoing LLA. Atherosclerotic occlusion of arteries leading to lower limb gangrene is overwhelmingly associated with old age and male sex. The Buerger disease patients are obviously a young male smoker. The problem of diabetic foot can affect both males and females equally.

Chigblo et al reported age range of 15 to 84 years in patients undergoing amputation with mean age 42.4 years.[5] Edison et al studied trauma patients and reported mean age among male patients 42.3 years and 47.5 years among female patients.[6] The elderly and the younger patients had peripheral vascular disease and trauma related amputations respectively, whereas the middle

aged had diabetic foot. Tumour related amputations were seen at both extremes of age.[7] In this study surprisingly no young adult/child with bone tumour was seen.

This study is in harmony with the other studies with male preponderance with male-female ratio of 3.1:1.[5-7]

Chigblo et al found trauma (70%) as the major cause of LLA followed by diabetic foot (21%) and peripheral vascular disease in his study.[5] Willey et al studied on peripheral vascular disease and concluded 52.8% patient underwent revascularization and 41% underwent amputation who developed chronic limb ischemia.[8] In the present study out of 27 patients of atherosclerosis, 6 patients underwent revascularization prior to the final decision of amputation.

Pendsey et al noted that the neuropathic foot with secondary infection among the diabetics is the commonest cause of LLA in India.[9] Among diabetic foot patients, a reported 90% patients had infectious cause for LLA and 3.8% had trauma related amputations.[10] In the present amputations due to vascular disease and diabetic foot was more common which shows pattern similar to that of developed nations. In this study below knee amputation is most frequent level of amputation which has also been established by many other studies. Chalya et al found higher rate of below knee amputation. Among 192 patients who underwent LLA in Nigeria, 73.9% major and 26.1% minor amputation.[7] Das et al founded below knee amputation more common than above knee amputation. They further concluded that in trauma distal portion of limb is most frequently injured and amputation is done as distally as possible to secure functional activity. Above knee amputation was more common in malignancy in their study.[11]

Edison et al observed post-operative complication in 27.5%, these complications were pneumonia (21.2%), acute kidney injury (15.1%), deep vein thrombosis (14.8%), surgical wound infection (8.4%) and severe sepsis (6.4%). They remarked postoperative complication were more in patients with compartment syndrome and patients with neurovascular injury.[6]

Chalya et al reported surgical site infection as the leading post-operative complication (21%). In their study 70.6% has positive growth, out of which 16.7% had polymicrobial bacterial growth. *Staphylococcus aureus* was most commonly isolated followed by *E. coli* and *Klebsiella* as 16.7%.[12] Umaru et al reported surgical site infection (28.3%), wound dehiscence (12.3%) and ascending gangrene (7.5%) as some of frequent complications.[13] In the current study 64.13% patients developed post-operative wound infection and there were 32.2% poly-microbial organism with *E. coli* as the most common organism.

In this study mortality was 7.6%, of which mostly patients died due to persistent sepsis with multiple organ dysfunction syndrome. Edision et al reported a 6.2% mortality in their study and suggested that age and presence of post-operative wound infection is the one of the predictors of mortality[6].

Willey et al noted 6.7% mortality in their study and proposed that the risk of mortality was higher among older and diabetic patients.[8] Omoke et al found 8.7% mortality with females having a higher percentage (17.1%) of mortality rate. They also concluded mortality rate higher among elderly and patients with pre-existing co-morbidities.[7]

Chigblo et al found 24% had a prosthesis fitted. Over all 70% had walking aid, 54% using walking stick, 16% crutches and 4% mobilize by wheelchair. Prosthesis fitted patients were more independent on walking than unfitted patients.[5] In this study out of 54 major LLAs, only 20 patients came up for prosthesis and overall 52.17% were able to mobilize.

The present study shows that LLA is a preventable health problem and can be achieved by educating the diabetic patient about the proper foot care, encouraging the society for daily regular physical exercise, by promoting smokers to quit smoking and by promoting the public to follow traffic guidelines to avoid road traffic accidents and their consequences. For lower limb amputee patients' promotion of fitting of prosthesis is needed for good rehabilitation and to avoid negative impact on social activity of the patient.

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