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Lower extremity amputation in Hong Kong

香港下肢截除手術的成果

Objective. To evaluate the characteristics and outcome of patients undergoing lower extremity amputation in Hong Kong.
Design. Cohort study.
Setting. University teaching hospital, Hong Kong.
Participants. One hundred and eighty-four Chinese adults who underwent lower extremity amputation.
Main outcome measures. Demographic data of the cohort, wound complication and revision amputation rates, prosthesis use, functional ambulation level and institutionalisation at postoperative 6 months, operative mortality, and long-term survival.
Results. The majority of patients (83.1%) who underwent lower extremity amputation were aged over 60 years. Vascular occlusive disease was the most common underlying pathology, followed by infection. The wound complication and operative mortality rates were high. Only 43.0% of patients were able to resume community ambulation at 6 months and 40.7% became institutionalised. After high-level amputations, 22.3% managed to use a prosthesis. The median survival after lower extremity amputation was 1008 days. High-level amputation was associated with lower wound complication and revision amputation rates, but an inferior functional outcome and survival compared with foot amputation.
Conclusions. Lower extremity amputation is associated with high morbidity and mortality, especially with high-level amputations. It places a heavy burden of care on patients, their families, the health care system, and society. Appropriate health care planning, provisions, and coordinated efforts at various levels are necessary to improve the situation. Major efforts must also be focused on preventing vascular occlusive disease and diabetes.

目的：歸納在香港進行的下肢截除手術的病人特點，並評估手術成果。
設計：群組研究。
安排：大學教學醫院，香港。
參與者：184 位接受了下肢截除手術的華裔成年人。
主要結果測量：研究對象的人口特點數據、傷口出現併發症和需作修正截除的比率、義肢的裝配、手術後第6個月的功能活動水平以及入住護理機構的情況、手術死亡率、術後的長期生存時間。
結果：大部分接受下肢截除手術的病人（83.1%）年齡在60歲以上，血管閉塞是最常見的截肢原因，其次為感染。傷口出現併發症和手術造成死亡的比率相當高。只有 43.0% 的病人能在術後第 6 個月回復一般社區活動，另有40.7%要入住護理機構。截除小腿或大腿後，22.3%的病人能運用義肢。截除下肢後生存的中位數為1008天。相對於只截除部份腳掌的病人，截除小腿或大腿的病人，傷口出現併發症和需作修正截除的比率較低，但回復功能較差，生存時間也較短。

Key words:
Amputation;
Chinese;
Mortality;
Treatment outcome

關鍵詞：
截肢；
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死亡率；
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結論：下肢截除手術，尤其是小腿或大腿的截除，引起其他病症和造成死亡的機會非常高，對病人、家屬、醫療保健系統，以至整個社會都造成沉重的壓力。要改善目前的情況，必須在各個層面進行恰當的醫療保健計劃、措施和協調。此外，也需要把大量精力投放在預防血管閉塞症和糖尿病之上。

Introduction

Lower extremity amputation (LEA) is a century-old surgical procedure. It is often performed when the limb is deemed non-salvageable following severe injury (eg war injury or road traffic accident), when there is tissue loss due to vascular occlusive disease, or to control infection. It is generally presumed that a prosthetic limb can replace the lost limb both cosmetically and functionally. Many studies have evaluated the outcome of LEA,[1-4] but few data are available for Chinese patients or the population of Hong Kong. Each locality has its own disease pattern, socio-economic structure, and heath care provision. Hong Kong has enjoyed peace and a low violent crime rate: this has minimised the need for LEA due to war injury or trauma. Vascular disease and diabetes mellitus, which are leading causes of lower extremity amputation in the United States and other developed countries, were once less prevalent in Asia. It has been suggested that people of Asian ethnic origin have lower incidence of diabetes-related LEA.[5,6] Nonetheless, an increasingly westernised diet and sedentary lifestyle combined with an ageing population are leading to an increased incidence of diabetes and atherosclerosis-related problems that may result in LEA. Lower extremity amputation in Hong Kong and its outcome have not been reviewed. Such information is important for clinical decision making, patient counselling, and health care planning.

Patients and methods

All adult patients who underwent an index LEA at the Prince of Wales Hospital in Hong Kong from January 1995 to June 1997 were identified. Medical records were reviewed for basic demographic data, medical co-morbidities, premorbid mobility and accommodation, cause and level of amputation, postoperative course, functional outcome, and mortality. The final level of amputation was defined by the most proximal amputation level associated with the index amputation, including revision amputation. Level of amputation was classified as foot amputation (all amputations performed at or distal to ankle joint level), below-knee amputation (BKA, all trans-tibial amputations with knee joint preserved), or above-knee amputation (AKA, amputations at or above knee level). Operative mortality was defined as all-cause mortality within 30 days of surgery. Subsequent yearly follow-up using a telephone questionnaire was carried out by a research assistant. Patients or their caretakers were asked to report the level of function and survival status. Last contact was made in December 1999. Mobility was graded according to the functional ambulation level[7]: independent community ambulator, limited community ambulator, unlimited household ambulator, limited household ambulator, supervised household ambulator, transfer, and bedridden.

Descriptive statistics were obtained for basic demographic characteristics. The outcome parameters for three major aspects were analysed: (1) early operative outcome (operative mortality, wound complications, and need for revision amputation); (2) functional outcome at 6 months (functional ambulation level and use of a prosthesis for high-level amputees); and (3) long-term survival. Univariate analysis was performed using contingency tables and Pearson's Chi squared test. Life tables and Kaplan-Meier survival curves were generated for survival analysis. The equality of survivor function was tested by log-rank test. All statistical tests were performed using the Statistical Package for the Social Sciences (Windows version 11.0; SPSS Inc., Chicago [IL], United States). Differences were considered statistically significant at a P value of less than 0.05.

Results

Medical records of 189 ethnic Chinese patients who underwent an index LEA during the study period were reviewed. The median follow-up period for those who remained alive following AKA, BKA, and foot amputation was 188, 226, and 233 weeks, respectively. Five patients with incomplete records were excluded from analysis. The demographic data of the remaining 184 patients are shown in Table 1. The majority (83.1%) of patients were aged older than 60 years. Almost half of all female patients were older than 80 years. Vascular occlusive disease was the leading cause of LEA, followed by infection. Trauma accounted for only 7.1% of cases. High-level

Table 1. Demographic data of patients undergoing lower extremity amputation

	Total, n=184	Male, n=93	Female, n=91
Mean age (SD) [years]	74.1 (15.2)	66.0 (17.1)	78.5 (9.5)
Age-group (years)			
21-40	4.9%	9.7%	0%
41-60	12.0%	19.3%	4.4%
61-80	51.1%	53.8%	48.4%
>80	32.0%	17.2%	47.2%
Indication for amputation			
Vascular occlusive disease	63.6%	63.4%	63.7%
Infection	27.7%	22.6%	33.0%
Trauma	7.1%	11.8%	2.2%
Tumour	1.6%	2.2%	1.1%
Level of amputation			
Above-knee	24.4%	25.8%	23.1%
Below-knee	47.3%	44.1%	50.5%
Foot	28.3%	30.1%	26.4%
Co-morbid conditions			
Diabetes mellitus	53.3%	44.1%	62.6%
Hypertension	42.9%	35.5%	50.5%
Ischaemic heart disease	13.0%	11.8%	14.3%
Cerebrovascular accident	20.7%	17.2%	24.2%
Congestive heart failure	9.8%	7.5%	12.1%
Chronic obstructive airway disease	3.8%	4.3%	3.3%
Chronic renal failure	4.9%	4.3%	5.5%
Blindness	3.8%	4.3%	3.3%
Mean No. (SD) of co-morbid conditions	1.8 (1.4)	1.6 (1.3)	2.0 (1.3)

amputations were performed in 71.7% of index LEAs. There was a high prevalence of medical co-morbidities: each patient had a mean of 1.8 co-morbid conditions. Diabetes mellitus was present in 53.3% of patients, of whom 95% had late-onset non–insulin-dependent diabetes mellitus. Atherosclerosis-related conditions, including hypertension, ischaemic heart disease, and cerebrovascular accident, were also common (Table 1).

Wound complications, including wound infection, wound dehiscence, superficial loss, and stump necrosis, occurred in 29.3% of all patients. Revision amputation was necessary in 21.2%. The operative mortality rate was 9.2% (17 patients died within 30 days of LEA). At postoperative 6 months, 43.0% of those who were community ambulators before surgery had resumed community ambulation. Of the 12 patients who had bilateral high-level amputations (seven high-level amputations after previous high-level amputations, five simultaneous bilateral high-level amputations), none could ambulate in the community. Following LEA, 40.7% of patients were institutionalised, compared with 23.4% on admission. Only 22.3% of those who underwent high-level LEA managed to use a prosthesis. Median survival after LEA was 1008 days (standard deviation [SD], 182 days; 95% confidence interval [CI], 652-1364 days).

All outcome parameters were significantly influenced by the level of LEA. Higher level LEA resulted in fewer wound complications and revision amputations, but severely compromised functional outcome and survival (Tables 2 and 3). Above-knee amputation was associated with an extremely high operative mortality of 19.2%, and 8.8% of amputees learnt to use a prosthesis. Community ambulation was resumed in only 15.4%, and 53.2% were institutionalised. Median survival was 8 months. Patients who underwent foot amputation had a significantly higher wound complication and revision amputation rates but a significantly lower operative mortality (2.4%). Most maintained community ambulation with a bipedal gait, and only a few required institutional care. Long-term survival remained higher than 50% (Fig).

Discussion

Most patients in Hong Kong who underwent LEA were aged over 60 years, and vascular occlusive disease was the most common underlying pathology. Almost half of all female patients were aged over 80 years. Many patients had multiple medical co-morbidities. The prevalence of diabetes mellitus (53.3%) was much higher than that of the local population (14.1% among elderly).[8] This pattern of LEA is similar to the general

Table 2. Outcome measures after lower extremity amputation (LEA)*

	Above-knee amputation	Below-knee amputation	Foot amputation	P value
Wound complication rate	17.8%	28.7%	40.4%	0.05
Revision amputation rate	11.1%	17.2%	36.5%	<0.01
Operative mortality rate	19.2%	6.6%	2.4%	<0.01
Community-ambulators who resumed community ambulation	15.4%	32.8%	87.1%	<0.001
Prosthesis use	8.8%	30.8%	Not applicable	<0.01
Institutionalisation (preoperative)	53.2% (34.0%)	43.5% (21.2%)	17.1% (8.5%)	<0.001

* Outcome measures were stratified according to the level of LEA performed and compared using analysis of variance. Foot amputations had significantly higher wound complication and revision amputation rates, but better survival and functional outcomes

pattern of LEA in western populations in terms of age, indications, prevalence of diabetes mellitus, and incidence of co-morbid conditions.[9-11]

Lower extremity amputation is associated with high morbidity and mortality but is mistakenly thought of as a routine surgical procedure without excessive risk. The wound complication rate is much higher than that following other lower-limb surgical procedures.[4,12,13] The need for revision amputation is particularly distressing, both for the patient and the surgeon. The operative mortality of LEA in this series is comparable with that of many high-risk surgical procedures such as mitral valve replacement and oesophagectomy.[14] If foot amputations are excluded, the operative mortality for high-level amputations is even more alarming. Long-term survival is variously compromised according to the level of LEA. Compromised long-term survival is not unique to our health care system; it is also reported by other centres.[10,15,16] Despite advances in medical care, there has been little improvement in survival after LEA.[17] With limited life expectancy, rehabilitation for these patients should set realistic goals and be speedy; unnecessary or prolonged hospitalisation should be avoided.

The functional outcome following LEA in the local population tends to be low. Functional outcome after high-level LEA is often measured by prosthesis use. Preservation of the knee is known to decrease the energy required for prosthesis use and increase the chance of successful ambulation.[18,19] The average rate of prosthesis use is reported to be 60%.[2,3] The local rates of prosthesis use (8.8% after AKA and 30.8% after BKA) are dismal compared with most centres. Without successful fitting of a prosthesis following high-level LEA, bipedal ambulation is impossible, and resumption of community ambulation is affected. The maintenance of community ambulation allows superior self sufficiency, less dependence, and less isolation. Resumption of community ambulation should be the goal in every case of LEA rehabilitation. Unfortunately, this was only achieved in 15% to 32% of patients after high-level LEA. The remaining patients became highly dependent on others for their daily activities and self care. Many families were unable to cope with the demand of taking care of a family member with a high-level LEA, and the patient became institutionalised.

Table 3. Median survival after lower extremity amputation*

	Median survival (days) (SD, 95% CI)
Overall	1008 (182, 652-1364)
Above-knee amputation	245 (85, 78-412)
Below-knee amputation	1036 (193, 658-1414)
Foot amputation	Survival remained over 50% up to 2158 days Mean survival, 1696 (123, 1454-1937)

* Median survival differed significantly with the level of amputations (P<0.001, log rank test)

Bipedal ambulation was preserved without the need for a prosthesis in patients who underwent foot amputation. They fared significantly better than patients with high-level LEA in all aspects of functional outcome. Most were able to return to community ambulation and did not need institutional care.

The low functional outcome after LEA in Hong Kong is partly related to the advanced age of the patients. At the time of admission, 34.2% of patients were non-community ambulators and 23.4% were living in institutional accommodation. A high-level LEA added an additional toll on these fragile elderly. The low premorbid functional status and multiple medical co-morbidities limited the number of patients who could be successfully fitted with a prosthesis, and many achieved only wheelchair ambulation. Those who learnt to manoeuvre their own wheelchair were

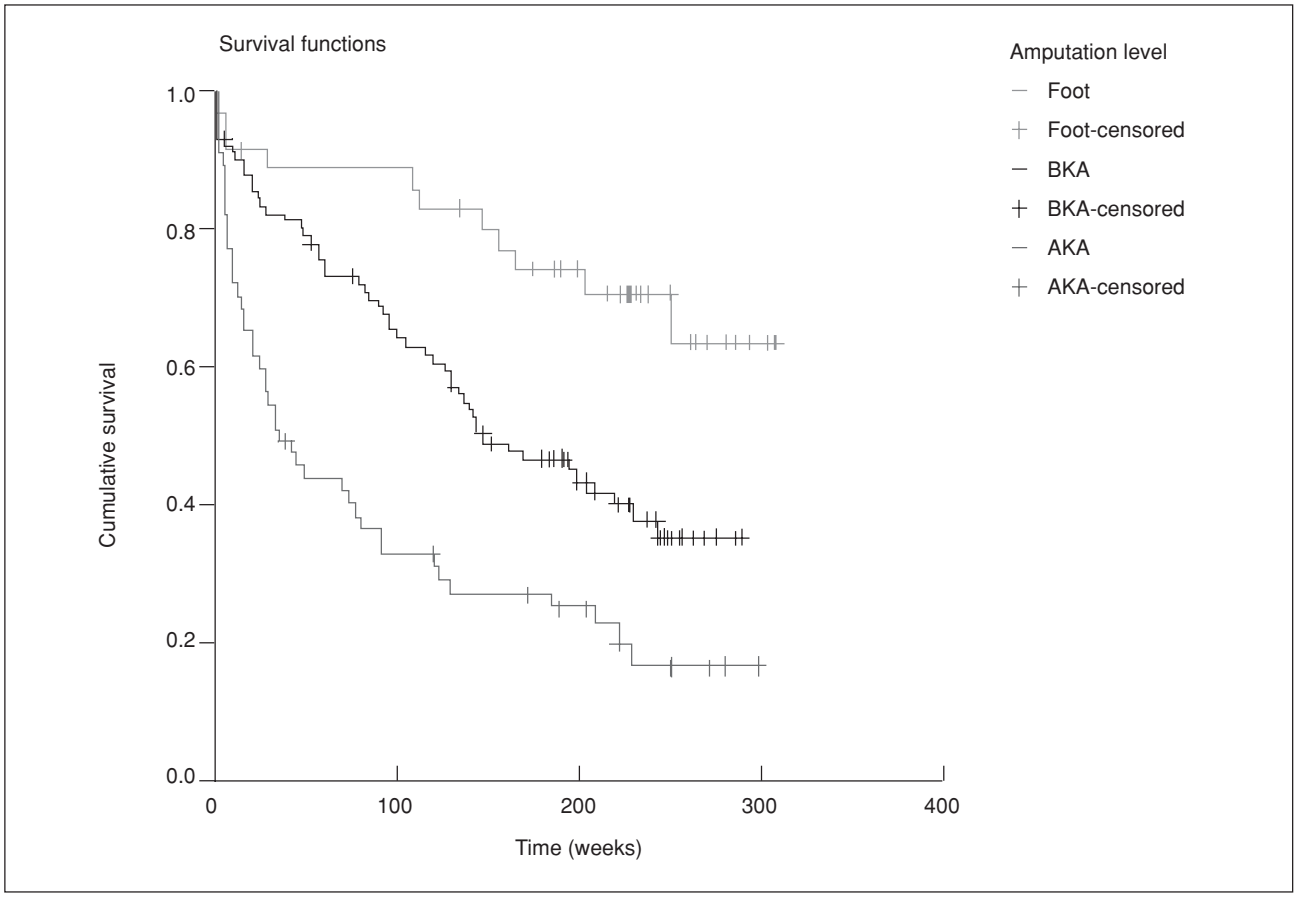

Fig. Kaplan-Meier survival curves after above-knee amputation (AKA), below-knee amputation (BKA), and foot amputation (P<0.001, log rank test)

able to maintain a certain level of independence: others were dependent on their caretakers for all their transfers and performing small tasks such as getting a glass of water.

The crowd living environment in Hong Kong and hilly landscape pose a challenge to outdoor wheelchair ambulation. Public transport increasingly offers motor platforms for wheelchairs and more buildings have wheelchair access ramps, but facilities for the disabled remain inadequate. Even for the young, it is a major challenge to brave a trip to the city centre in a wheelchair. Community ambulation becomes increasingly difficult for elderly amputees who eventually resign themselves to a life indoors.

The high morbidity and operative mortality during acute hospitalisation, together with the subsequent long-term functional deficit, high dependency, and low survival after LEA, cast a heavy burden not only on patients and their families, but also on the health care system and society. Improvement in outcome is much desired. The geriatric population in Hong Kong increased from 6.6% in 1981 to 12% in 2001. With an increasing life expectancy, this proportion is expected to exceed 30% by 2050.[20] The number of patients suffering from vascular occlusive disease and diabetes is also expected to increase, so as the number of LEAs performed each year. Recognition of the problem with appropriate health care planning and provision is necessary. This can be achieved by coordinated efforts and improvements targeted at various levels. These include improving peripheral circulation by control of atherosclerosis and active vascular intervention,[21,22] limb salvage with selective performance of foot amputation instead of high-level amputations,[23,24] increasing the chance of prosthesis use by concentrated efforts in amputation rehabilitation,[4,25] popularisation of motorised wheelchair, and improving facilities and access for the disabled. Medical care should also focus on preventing vascular occlusive disease and diabetes, the underlying causes for most cases of LEA.

Conclusion

The majority of LEAs in Hong Kong are performed

on geriatric patients with vascular occlusive disease. Lower extremity amputation is associated with high morbidity and mortality, especially with high-level amputations. The suboptimal outcome poses a heavy burden on both patients and society. Appropriate health care planning and provision at various levels are vital to maximise the functional outcome for patients.

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