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Major lower limb amputations in Far North Queensland

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Key words
amputation, diabetes, Indigenous, major amputation.

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Accepted for publication 28 November 2018.

doi: 10.1111/ans.15031

Abstract

Background: Major lower limb amputation is a devastating operation most commonly performed for complications of peripheral artery disease or diabetes mellitus. Data suggest that there is a widespread variation in major amputation rates within and between countries. This study aimed to identify key characteristics of patients undergoing this procedure in our region, and to compare our population to the rest of Australia. Secondary analysis was performed to assess differences seen in the Indigenous population.

Methods: Cases were identified from a prospectively maintained database and medical records were retrospectively reviewed to record relevant clinical information. A literature review was then undertaken to compare our data to other series.

Results: A total of 51 major lower limb amputations were performed between January 2015 and January 2017, and the mean age of patients was 59.5 years. Over 70% of patients were diabetic, and one-third required dialysis. Twenty-three patients were identified as Indigenous, and they were significantly younger (54.6 ± 11.4 versus 63.5 ± 15.9 years, $P = 0.02$) and more likely to be diabetic (91.3% versus 65.2%, $P \leq 0.01$) compared to non-Indigenous patients. The most common indication was arterial ulcer or gangrene (52.9%), but Indigenous patients were more likely to have amputation due to sepsis (47.8% versus 7.1%, $P < 0.01$).

Conclusion: Patients undergoing major amputation in Far North Queensland are more likely to be younger and diabetic than Queensland or Australian counterparts. Diabetes and renal disease were especially prevalent in our cohort, with higher rates found in Indigenous patients.

Introduction

Major lower limb amputation (MLLA), commonly defined as amputation of the limb above the level of the ankle joint,[1] is a significant surgical procedure which has a dramatic impact on patient's quality of life from both a physical and mental well-being perspective.[2] Worldwide, MLLAs are reported to be most commonly indicated for complications of peripheral artery disease, complications of diabetes mellitus or more rarely due to trauma or malignancies.[3,4] Lower limb amputations, particularly in the context of diabetes, have been used as an indicator internationally to compare different health systems performance.[1,5–8] Both Australian and international reports have shown that there are geographical variations in the incidence of MLLAs within nations.[9–12] The most comprehensive report looking at geographical variation within Australia suggested further research to be focused on smaller geographical regions to determine specific at-risk populations for lower limb amputations.[11]

Cairns Hospital (CH) services a unique population as the only major referral hospital in Far North Queensland (FNQ), with a population density of 1.77 people/km^2 for the Cairns and Hinterland Hospital and Health Service.[13] The Cairns and Hinterland region has 12.6% of residents identifying as Indigenous, and services the Torres and Cape Health Service with 64% of their population identifying as Indigenous.[14] This is in comparison to 4% of the total Queensland population.

The aim of this study was to identify the key characteristics of contemporary patients who undergo MLLA at CH and compare the results with other parts of Australia. The secondary aim was to identify any differences in the clinical presentations or demographics between the Indigenous and the non-Indigenous groups.

Methods

Cases were identified from the prospectively collected National Vascular Database (www.ava.net.au) into which all cases are personally entered by the individual vascular surgeons. The electronic medical records were then reviewed and information including demographics, type of operation, indication for operation, co-morbidities and short-term outcomes were recorded. Separate MLLA procedures carried out on the same patient (i.e. below knee amputation (BKA) on both legs or BKA followed by above knee amputation) were considered for the purposes of the study as separate cases. Statistical analysis was performed using GraphPad Prism (GraphPad Software, San Diego, CA, USA). Chi-squared tests were used for comparing non-continuous variables, and Welch's unpaired *t*-test used for continuous variables. Two-sided *P*-values were obtained, and a value of <0.05 was deemed statistically significant.

Prior to data collection, ethics exemption was obtained from the FNQ Human Research Ethics Committee. After results were obtained, a literature search was conducted to identify similar studies and compare results.

Results

A total of 51 MLLAs were performed on 46 patients by the Vascular Unit at CH between January 2015 and January 2017. The mean age of patients was 59.5 years (range 18–83 years). Thirty-five amputations (68.6%) were performed on men and 16 (31.4%) on women. Men (mean age 60.1 ± 16.3 years) and women (mean age 58.3 ± 10.6 years, $P = 0.64$) showed no significant differences in age at amputation. Thirty-two (62.7%) BKAs, 18 (35.3%) above knee amputations and one (2%) through-knee amputation were performed.

Patients undergoing MLLA procedures did show a high prevalence of medical co-morbidities (Table 1). Over 70% ($n = 36$, 70.6%) of patients had a diagnosis of diabetes mellitus, and one-third ($n = 17$, 33.3%) had end-stage renal failure necessitating dialysis treatment. There were four deaths (7.8%) within 6 months of procedure. Eighteen amputees (35.3%) progressed to using a prosthesis following their surgery.

Approximately three-quarters of patients ($n = 38$, 74.5%) had limb salvage or revascularization procedures (including endovascular procedures) prior to their major amputation. Twenty-one (41%) patients experienced at least one complication, with the most common complications recorded being infection ($n = 10$, 19.6%) and wound breakdown ($n = 7$, 13.7%). Rarer complications were identified as post-operative haematoma ($n = 3$, 5.9%) and pneumonia ($n = 3$, 5.9%).

Twenty-three (45.1%) MLLAs were performed on patients identifying as Aboriginal or Torres Strait Islander heritage, and the male-to-female ratio was not significantly different between Indigenous and non-Indigenous amputees ($P = 0.17$). Simple univariate analysis showed that Indigenous amputees were significantly younger (54.6 ± 11.4 years) compared to non-Indigenous amputees (63.5 ± 15.9 years, $P = 0.02$). All but two of the Indigenous patients undergoing MLLA were diabetic ($n = 21$, 91.3%), compared to roughly two-thirds of non-Indigenous patients ($n = 15$, 65.2%, $P \leq 0.01$). In addition to diabetes mellitus, Indigenous patients were more likely to be diagnosed with chronic kidney disease ($n = 14$, 60.9%) compared to non-Indigenous patients ($n = 8$, 34.8%, $P = 0.04$). Non-Indigenous patients were less likely to have a BKA ($n = 13$, 46.4%) compared to the Indigenous cohort ($n = 19$, 82.6%, $P = 0.02$). There were no significant differences identified in the remainder of the recorded patient data (Table 1).

The most common indication for MLLA in our patient cohort was arterial ulcer or gangrene, responsible for over half of the total amputations ($n = 27$, 52.9%). The other main indication for amputation was infection or sepsis, responsible for approximately one-quarter of MLLAs ($n = 13$, 25.5%). Other indications included non-arterial ulcer, rest pain, acute ischaemia, trauma and snake bite envenomation (Table 2). Those patients identifying as Indigenous were much more likely to have infection as an indication for amputation ($n = 11$, 47.8%) compared to non-Indigenous amputees ($n = 2$, 7.1%, $P \leq 0.01$).

Basic statistical comparison of our data with a similar study from a metropolitan coastal hospital in Australia[15] demonstrated that our

Table 1 Clinical factors identified in patients undergoing major lower limb amputation

	Overall $n = 51$	Indigenous $n = 23$	Non-Indigenous $n = 28$	*P*-value
Male	35 (68.6%)	13 (56.5%)	22 (78.6%)	0.17
Age (years)	59.5 ± 14.6	54.6 ± 11.4	63.5 ± 15.9	0.02*
Diabetes mellitus	36 (70.6%)	21 (91.3%)	15 (65.2%)	<0.01*
Dialysis	17 (33.3%)	11 (47.8%)	6 (26.1%)	0.09
Chronic kidney disease (stage 3+)	22 (43.1%)	14 (60.9%)	8 (34.8%)	0.04*
Time to amputation (days)	9.9 ± 15.0	7.6 ± 10.1	11.8 ± 18.0	0.30
Length of stay (days)	30.1 ± 35	24.0 ± 21.6	35.1 ± 42.8	0.23
Below knee amputation	32 (62.7%)	19 (82.6%)	13 (46.4%)	0.02*
Ischaemic heart disease	25 (49.0%)	11 (47.8%)	14 (50.0%)	0.88
Hypertension	41 (80.4%)	18 (78.3%)	23 (82.1%)	0.72
Prior surgical intervention	38 (74.5%)	15 (65.2%)	23 (82.1%)	0.29
Complication	21 (41.2%)	6 (26.1%)	15 (53.6%)	0.09
Prosthesis	18 (35.3%)	6 (26.1%)	12 (42.9%)	0.34
Mortality at 6 months	4 (7.8%)	3 (13%)	1 (3.6%)	0.47

*Statistically significant value. Nominal variables expressed as *n* (%), with *P*-values determined by chi-squared test. Continuous variables expressed as mean ± SD, with *P*-values determined by Welch's unpaired *t*-test. Level of statistical significance considered to be <0.05.

Table 2 Indications for major lower limb amputation

Indication	Overall $n = 51$	Indigenous $n = 23$	Non-Indigenous $n = 28$	*P*-value
Arterial ulcer/ gangrene	27 (52.9%)	10 (43.5%)	17 (60.7%)	0.34
Infection	13 (25.5%)	11 (47.8%)	2 (7.1%)	<0.01*
Non arterial ulcer	5 (9.8%)	1 (4.3%)	4 (14.3%)	—
Rest pain	2 (3.9%)	1 (4.3%)	1 (3.6%)	—
Acute ischaemia	2 (3.9%)	—	2 (7.1%)	—
Trauma	1 (2.0%)	—	1 (3.6%)	—
Snakebite	1 (2.0%)	—	1 (3.6%)	—

*Statistically significant value. Data expressed as *n* (%), with *P*-values determined by chi-squared test.

patients were significantly younger (59.5 $\pm$ 15 versus 70.1 $\pm$ 14.3 years, $P \leq 0.01$) and more diabetic (70.6% versus 49.4%, $P = 0.02$).

Discussion

Whilst there are no directly comparable data, comparison to national data gathered from patients undergoing both minor and MLLAs between 2007 and 2012 suggests that patients undergoing MLLA in Cairns are younger than both the Queensland and Australian average (59.5 versus 61.4 and 62.9, respectively).[11] Using the same set of data, Cairns amputees also had higher rates of diabetes mellitus compared to national and state averages.[11] The patients observed in this audit are also younger and have higher rates of diabetes compared to other cohorts of patients undergoing amputations in larger tertiary hospital settings in Australia.[4,15]

Previous reports from FNQ up to 20 years ago looking specifically at diabetic patients prove that lower limb amputations and infections have long been recognized problems endemic to this area.[16] The findings in this study relating to the frequency of amputation in younger Indigenous patients have been well documented. A study of a cohort of diabetic patients undergoing amputation between 1998 and 2008 in the same hospital as this study showed Indigenous amputees were 14 years younger than non-Indigenous patients.[17] In the same study, sepsis was documented as the indication for amputation more frequently in Indigenous patients, a finding mirrored in this contemporary cohort.[17] These results are consistent with studies from two other states in Australia with a high proportion of Indigenous residents,[11,18,19] as well as another hospital in North Queensland.[20] Outside of Australia, ethnic differences in the rates of MLLA have been documented in multiple regions, including higher rates in African-American and Hispanic men in America.[12,21] It has been proposed that mostly socioeconomic and geographical factors related to ethnicity, as well as financial and cultural barriers to accessing appropriate health care are implicated in these international cohorts.[12,22]

The cause for the discrepancy between the Indigenous and non-Indigenous cohorts in our study is clearly multi-factorial and a complicated issue. Indigenous Australians have poorer health outcomes in a variety of measures, with particularly high rates of diabetes clearly demonstrated to be a major causative factor for limb amputation.[19,23–26] A study from Townsville found that Indigenous patients were over-represented in their dialysis-dependent population, and that these patients were more likely to require MLLA compared to non-Indigenous patients on dialysis.[27] Previous reports have demonstrated that Indigenous Australians were four times more likely to be hospitalized for diabetes than non-Indigenous Australians, and an age-adjusted death rate from diabetes six times higher than non-Indigenous counterparts.[28]

Diabetes is clearly a major contributor to MLLA in FNQ. Rates of diagnosis of diabetes has been increasing in recent years in Australia, but the prevalence of diabetics undergoing lower limb amputation has decreased.[29,30] One study looking specifically at the Queensland population between 2005 and 2010 found a 56% increase in people diagnosed with diabetes during that period.[30] The same study concluded that there was a significant reduction in diabetic foot-related hospitalization amputations in Queensland over the same timeframe.[30] This trend has been observed in other parts of Australia, with a Western Australian study also showing a reduction in amputations over a similar period.[31] It has been proposed that this may reflect improved primary and secondary prevention, as well as improved recognition and management of foot ulcers.[29] In particular, multidisciplinary organizations such as Diabetic Foot Australia[32] have been crucial in connecting clinicians across Australia and partnering with Government and industry to raise awareness and education regarding best practice prevention and management of diabetic foot disease.

About one-third of patients undergoing MLLA in Cairns were dependent on dialysis, and no other Australian data were found to compare this to. A study from Townsville found that of the 218 dialysis-dependent patients, 13.3% had undergone a lower limb amputation, with a total of nine patients (4%) undergoing MLLA.[27] Interestingly, all dialysis-dependent patients undergoing lower limb amputation also had concurrent diabetes.[27] Multiple studies have concluded that patients requiring dialysis are at higher risk than the general population for MLLA, and this study confirms that in our cohort.[33–35] It has also been suggested that there is a correlation between the severity of chronic kidney disease and amputation, which may be independent of clinically apparently peripheral artery disease.[35]

The rates of BKA in this study as a proportion of total MLLAs (62.7%) was comparable to other Australian cohorts, with Lim *et al.*[15] reporting 58.6% and a study looking at 5 years' worth of data from all Australian states reporting 57.3%.[11] This study found that Indigenous patients were significantly more likely to undergo BKA as opposed to above knee amputation, and one hypothesis for this could be due to sepsis being a more common indication, necessitating immediate definitive intervention. The rate of patients using prosthesis in our cohort was comparable to similar Australian and overseas cohorts.[15,36]

This study had limitations typical of a retrospective chart review, in that it could only identify correlation not causation, and there were likely important factors not routinely recorded or accessible on retrospective review. Only MLLAs performed by vascular surgery teams were included, and therefore some cases from the relevant period may not have been included. We have identified that

there is a high prevalence of diabetes in our cohort of amputees, who are younger than their nationwide counterparts. Indigenous patients were over-represented and are still significantly younger and more diabetic than non-Indigenous patients.

Further efforts must be made in preventative health and education regarding diabetes and its sequelae in at-risk populations. It is crucial that this is done in a multidisciplinary way, with the involvement of podiatrists, primary health care, specialist nurses and policymakers crucial in the prevention of avoidable amputations.

Conflicts of interest

None declared.

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