CASE REPORT

Clinical management of quadriplegia in low and middle-income countries: a patient's road to physiotherapy, prostheses and rehabilitation

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SUMMARY

Here we discuss the follow-up case of a 27-year-old male patient from rural Philippines, who was neglected by local health services after losing all four of his limbs as a result of a high-voltage electrical accident. The case follows the patient's road to accessing prostheses, rehabilitation health services and physiotherapy. Significant disparities were found between the government health services and the private sector with respect to quality, accessibility and affordability. Access to affordable healthcare is a basic human right that must be a priority for low-income and middle-income countries.

CASE PRESENTATION

Medical history of the patient's accident and treatment

This patient was encountered in 2016, while conducting an infectious disease clinical trial in Northern Samar, the Philippines (figure 1A). On examination, he had scars to 25% of his body, with dark pigmentation under both axillae. Both upper and lower limbs had been amputated to below the olecranon and patella. Prior to the patient's injuries, he worked as a metal and glass welder. The accident occurred in 2011, in Metro Manila, when the patient struck an overhanging wire which transmitted 20 000 V through his body as he was preparing to weld an iron bar. After several weeks of hospitalisation, the patient was discharged and did not receive any further instruction on obtaining prostheses, physiotherapy or rehabilitation. The patient travelled home (figure 1, left) and was assisted by his mother, who received no financial or medical assistance from the local, provincial or national government. Further clinical details on the initial BMJ Case Report can be found at <http://casereports.bmj.com/content/2017/bcr-2016-218188.long>

Medical prostheses, rehabilitation and physiotherapy

In early 2017, a charity crowd fund was set up for the patient (<https://www.gofundme.com/chkpqi-electrifying>). Towards the end of 2017, the charity had raised sufficient funds to assist the patient in obtaining lower limb prostheses, physiotherapy and rehabilitation. Quotes were received from both the public and private sectors. It was decided that

the patient would receive prosthetic limbs from a private independent company, Ottobock. Ottobock has a long international history of assisting and supplying quality services for amputated patients which were deemed superior to those provided by the national government.

The Ottobock physician followed the treatment circle model (figure 2,¹) to supply the patient with his specific needs. For the quadriplegic amputee patient, nine steps were used to allow the patient to have lower limb prosthetics. These are (1) assessment, (2) therapy, (3) fitting recommendation, (4) patient measurement, (5) prostheses production, (6) fitting, (7) rehabilitation, (8) quality check and (9) follow-up. The treatment for upper limbs required a different approach, but a similar model.

On meeting the patient, the physician assessed the remaining locomotion and ability of his lower limbs. The patient was highly active and had been able to flex and extend his knees for the last 6 years. It was noted that the patient's lower limb amputation (below the patella) had a shorter crus shunt, thus the fitting of a prosthetic socket proved challenging. It was recommended that the patient has a modified limb shunt socket and a carbon fibre composite foot for the lower extremities. The measurements for the lower limb prosthetics are typically made from the patient's original height before the accident. However, in this case, it was unknown. An alternative method was used to calculate the patient height, which was the head circumference multiplied by three. The length of the crus shunt was then measured. The prosthetic limbs were manufactured in Germany and then shipped to the Philippines. The lower limbs came in two parts, a silicon linen shuttle to be custom fitted with a laminated resin for the socket (for the limb shunt) and a crus extension component. The crus extension component was primarily made out of aluminium with a carbon foot attached. Adjustments were made to have the socket moulded in a shape matching that of the patient's crus shunt for correct fitting of the prosthetics. The length of the limb extension component was set to a shorter length. This was done to allow the patient to adjust to the increase in the centre of gravity. The patient was asked to slowly walk across the room, with assisted railings for balance. Over time, the length of the limb extension component was slowly lengthened (1–2 cm), depending on patient comfort,

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Figure 1 (A) The patient in wheelchair. (B) The patient postrehabilitation with lower limb prosthetics.

stability and success in walking. This would be raised until the original height of the patient was met. Additional criteria were used to measure the activity of the patient with the prostheses, such as don and doff orthotics (adding and removing prostheses), walking up and down steps, standing to sitting and vice versa. The rehabilitation process was completed in late February (2018) with Ottobock manufacturing and fitting the upper limb components (figure 1B). A similar protocol was followed as with the lower limbs.

GLOBAL HEALTH PROBLEM LIST

- ▶ What are the options in receiving prostheses and physiotherapy from the government and private sectors in low-income and middle-income countries (LMICs)?
- ▶ What disparities exist between the government health services and the private sector with respect to prosthetic quality, accessibility and affordability?
- ▶ How can health insurance be made affordable for indigent people in LMICs?

GLOBAL HEALTH PROBLEM ANALYSIS

There are currently over 600 000 amputee patients living in the Philippines.² This contributes a large social and economic burden to both the society and the individual. More specifically, the burden contributes to a significant strain on the nation's health-care services and providers struggle to provide basic services which are essentially non-existent in the rural areas. Patients have low salaries thus have to rely on local and international charities for financial assistance as public services are difficult to obtain. One of the local charities that the patient's relatives tried to gain support from was the Philippine Charity Sweepstakes. At the time of the patient's accident, it had extended waiting times (eg, 2–4 years) for financial assistance. The local charity cannot provide for all indigent patients hence many return home without help. A fact sheet issued by the Amputee Coalition, a US-based donor-supported, non-profit organisation, has indicated that three important steps are needed to apply for assistance for an amputee patient.³ These are (1) determine what assistive device(s) you will need, (2) get a prescription for the prostheses and their accessory equipment and (3) gather personal information which includes employment history and health insurance information. In LMICs, the access to information, particularly where to receive prostheses services, is often brief or absent on hospital discharge. The Amputee Coalition supplies a list of non-profit organisations where patients can

Figure 2 Ottobock treatment circle model.

apply for financial assistance, with each agency offering unique requirements which are specific to the patient's needs. They also supply contact details for health systems, which are US based, where a patient would receive the most out of their possible benefits, depending on where they live. LMICs should promote and introduce informational assistance to amputees following the example of the Amputee Coalition, where there are both online and phone assistance. LMICs' charities should also follow suit of their international counterparts, by providing easy access to information on possible financial support and health services, whether online or by phone (eg, amputee hotline) assistance. The Philippines national healthcare provider, PhilHealth, does provide such a package of services to amputee patients.

In 2013, the Filipino government introduced a *Z MORPH* package from PhilHealth which made prostheses available for people who had lost a limb.⁴ This was done to allow patients who lost a single limb to be physically able to return to work. This insurance premium covers P95 000 (US\$1845) for below knee lower limb prostheses and P60 000 (US\$1167) for below elbow upper limb prostheses.⁵ However, this requires the patient and the patient's employer to pay a premium contribution total of P200–P875 (US\$3.9–US\$17) monthly based on their salary.⁶ The average family household savings in Metro Manila is P3084 (US\$60) per month.⁷ Patients with lower salaries cannot afford such premiums because of the high cost of living in urban areas such as Metro Manila. The price of prostheses from the national government orthopaedic hospital cost P40 000 (US\$785) for lower limbs and P80 000 (US\$1375) for upper limbs prostheses, respectively. The purchasing of prostheses is only part of the problem, as the cost of physiotherapy and rehabilitation can be extremely expensive for indigent patients, ranging from P10 000 to 20 000 (US\$195–US\$389) per week. The package only provides benefits for patients with one limb amputated not with two, three or four.

If the patient has two or more amputated limbs, the complications become a significant burden. For example, they may not be able to afford or be fully covered for physiotherapy, prostheses and rehabilitation by national insurance policies. Independent health services provide all necessary services for a patient but at a considerable cost. For our quadriplegic patient, the total cost was P222 721 (US\$4334) and P342 496 (US\$6665) for lower and upper limbs, respectively. Help was provided by government in that a person with disability is granted a 20% discount⁸ which was included in the total cost of the service package. The time and care given to the patient in the private sector involves a client-based system, where a physician and at least two to three assistants are allocated to one patient. In public services, this is simply not possible, where bulk production of prostheses and group physiotherapy is a common practice and there is only one physician for every five patients. This is because of the overwhelming demand for such health services and a physician shortage. Governments from LMICs should give more resources and attention to these services in order to get disabled people back to the workforce. The health and safety standards found in the LMIC workforce and the education employee received about their workplace safety is entirely voluntary and is not enforced by the government. Further workplace safety policy details can be found in the initial case report of this patient.

There are many orthopaedic surgeries and clinics in the Philippines, with the majority of them near the capital city of Manila.⁹ This is an issue, as there is a lack of health services for those living in the remote areas of the Filipino archipelago. For example, a government medical facility called the Philippine Orthopaedic Centre in Quezon City (Manilla) is a 700-bed

hospital that specialises in musculoskeletal disorders.¹⁰ It was provided by the government's Department of Health in order to serve traumatic and orthopaedic patients in the country. However, a patient from the rural Philippines would be unable to gain access to such a facility due to their inability to pay for transport and accommodation while staying in a major urban centre.¹¹ A country which once faced a similar national health complication with prosthetic services is Malaysia.

Malaysia is located in South-east Asia and has a similar demographic profile as the Philippines. However, when it comes to prosthetics availability for its citizens, they provide prosthetic services at the national, state and district (local) level. With the introduction of these services at each level, there was a dissemination of information for indigent patients on how to access such services. In the 1970s, there was an emerging sector of private prosthetic companies which contributed to a major shift in Malaysian health policy in that government decided to outsource all medical services including prosthetics.¹² This was applied to both the public and private sectors of the national healthcare system. The intention of the government was to increase competition, reduce costs and increase access of low-income families. The downside of the policy was the lack of a governance body to regulate the standards of price and quality control for prosthetic services. There is currently a fluctuation in prices and the quality of such services for prosthetics. Most of the prosthetics, equipment, prosthetic parts, services and providers have been outsourced from developed nations (eg, European Union and North America). In 1998, a conference was set up by the International Society of Prosthetics and Orthotics which allowed Malaysian health officials to exchange knowledge and experience in prosthetics and orthotics with other LMICs. The Malaysian model, despite its limitations, has been deemed to be adequate in supplying psychosocial support and rehabilitation services, and thus serve as a model for other LMICs such as the Philippines.¹³ Developed countries have made great strides in research to ensure availability and affordability to their amputee citizens.

An innovative idea that has been in development and used in developed countries is three-dimensional (3D) printed prosthetic limbs. Prosthetic limbs of all shapes and sizes are printed predominately using acrylonitrile butadiene styrene and polylactic acid material.¹⁴ These materials, when formed, are more durable, flexible and light-weight than their conventional manufacturing counterparts. The maximum material cost of a 3D printed upper limb prosthesis costs US\$500,¹⁴ which can make prostheses more affordable to patients from LMICs. In 2017, a patient had their right prosthetic hand 3D printed for under US\$20. The patient's right limb was measured and 3D scanned to create a model customised to their needs. It took 8 hours to print the components and within 20 min to assemble the prosthetic hand.¹⁵ Another case study in the same year produced a carbon fibre and nylon composite anatomically scalable transfemoral prosthetic knee. This 3D printed knee was able to perform higher peak knee flexion. The patient's prosthetic knee was able to be used in daily activities and had the potential to be used as a running knee.¹⁶ 3D-printed prosthetic limbs provide a promising source of personalised prosthetics, where the socket, colour, shape and size can be tailored to the amputee's specific needs. The production of 3D printed prosthetics can potentially provide limbs for LMICs where there is a significant demand for high quality and affordable products.

To find resolution in the Philippines and in other LMICs, governments should provide higher workplace safety standards and affordable workplace health insurance schemes in order to

prevent and reduce the burden of accidental injury. They should also invest in new technologies that can provide better availability and affordability for indigent patients. The number of patients using public health systems in LMICs is expected to rise exponentially in the coming decades. Health policy needs to be created now in order to address this growing burden of disease.

Learning points

- ▶ Healthcare insurance policies in many low-income and middle-income countries (LMICs) lack support for indigent patients with amputations. Therefore, there is an urgent need to establish the necessary infrastructure for such amputee patients.
- ▶ There are significant disparities between the government health services and the private sector with respect to the quality, accessibility and affordability of prosthetic limbs.
- ▶ Local hospitals need to supply amputated patients on discharge with up-to-date information regarding how and where to receive appropriate medical assistance.
- ▶ Access to affordable healthcare is a basic human right that must be a priority for LMICs.

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