

Discovering Nepal in the Global Milieu of Stroke Rehabilitation: A Narrative Review

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ABSTRACT

Background: Stroke is the leading cause of long-term disability and death worldwide accounting for 12.2 million new cases, 101 million prevalent cases, 6.55 million stroke related deaths. The prevalence of stroke contributed to 7.6% of total deaths and 3.5% of total DALYs (years of healthy life lost) in Nepal. Stroke can result in a large variety of motor and non-motor symptoms and signs but the most common among all is the motor impairments. Those patients, who survive the initial period, might face the greatest long-term effect in development of impairments, limitation of activities and reduced participation in the community. As the number of survivors with disability and chronic care needs grows, rehabilitation will play an increasingly important role in the stroke management. The identification and utilization of best treatment approach and innovations in global and national/local level have been recognized as the top priority for overall and optimal recovery of person with areas of affection in multiple domains.

Purpose: This article presents a review regarding the historical trajectories of stroke rehabilitation in the world, the evidence suggesting the evolving landscape of global trends and innovations in stroke rehabilitation, the history of rehabilitation concept of Nepal, the evidence surrounding the Incidence and comprehensive management of stroke in Nepal, it also explores the current trends of stroke rehabilitation in the context of Nepal providing useful feedback and discovers the necessity of utilization as well as future research to be carried out to meet the global fashion.

Conclusion: Based on the synthesis of evidences, we suggest that stroke rehabilitation concept in Nepal from the physiotherapy perspectives lags far behind from global innovations and current trends as evidenced by very minimal articles. The extensive search of researches shows: Early mobilization, constraint induced movement therapy, motor relearning program, telerehabilitation, task-oriented training, basic robotics and conventional exercises in practice for stroke rehabilitation. Thus, this provides a future direction for many skilled trainings, researches and innovations to be discovered for stroke rehabilitation in the context of Nepal.

Keywords: Stroke; History; Stroke rehabilitation; Trends and innovations; Nepal

INTRODUCTION

Stroke is the leading cause of death and long-term disability worldwide, the global incidence risk of stroke has been increasing in particular 12.2 million new cases, 101 million prevalent cases, 6.55 million stroke related deaths were reported [1]. More than three fourth of stroke occur in low-and middle-income countries of which stroke contributed to 7.6% of total deaths and 3.5% of total DALYs (years of healthy life lost) in

Nepal [2]. Stroke caused by the rupture or obstruction of blood vessels in the brain is associated with substantial economic costs and it has created greater burden on health care system [3,4]. As, stroke can result in a large variety of motor and non-motor symptoms and signs but the most common among all is the motor impairments [5]. Those patients, who survive the initial period, might face the greatest long-term effect in development of impairments, limitation of activities and reduced participation [6]. As the number of survivors with disability and

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chronic care needs grows, rehabilitation will play an increasingly important role [7].

Stroke rehabilitation encompasses all aspects of stroke care, where the primary emphasis of stroke rehabilitation revolves around restoring compromised movement and functionality to minimize disability and promote active engagement in daily routines and tasks. It is a dynamic process with three primary objectives: Preventing functional decline, enhancing capabilities, and striving to attain the highest level of independence despite enduring stroke-related impairments [8]. Multidisciplinary team provides the effective delivery of the stroke rehabilitation, as stroke rehabilitation is the dynamic process with the overall aim of reducing stroke related disability [6].

Stroke rehabilitation follows a cyclical procedure that involves four essential stages: 1) Assessment phase involves evaluating and quantifying the specific needs of the patient; 2) Goal setting with realistic and achievable objectives for improvement defined during this stage; 3) Intervention with various techniques and therapies are employed to support the patient in reaching their set goals; 4) Reassessment: Progress towards the agreed-upon goals is regularly reviewed and assessed [9]. Stroke rehabilitation typically starts from acute phase (24-48 hours) post stroke and continues to the community and outpatient setting [10]. In the rehabilitative treatment of stroke patients with hemiplegia, prediction of recovery is very important. Accurate prediction facilitates proper setting goals of intervention for individual patients, thus improving the quality and efficiency of rehabilitation services [11].

Breakthroughs in neuroimaging and neurophysiological techniques have transcended conventional bedside observation, enabling researchers to gain deeper insights into the neurological processes driving behavioral improvement in stroke patients. This enhanced understanding has paved the way for clinical trials that explore the effectiveness of various interventions, such as pharmacological, cell-based, device-based, activity-based, and other approaches, aimed at promoting brain repair after a stroke and maximizing the outcomes of stroke rehabilitation [2,3].

Although stroke rehabilitation administered in a stroke unit has proven to be a highly efficient care model, leading to decreased mortality and dependency rates, the precise mechanisms underlying its effectiveness remain uncertain. The optimal implementation methods and the specific demographic that benefits the most from these treatments are still not entirely clear. Furthermore, determining the appropriate timing for initiating and concluding such interventions poses another challenge [5,6]. Therefore, we need to explore the history and global trends of rehabilitation so that we can compare, learn and explore more on stroke rehabilitation in Nepal. In this article, we will discuss the trajectories, current trends and advancement of rehabilitation of stroke.

EVOLUTION OF STROKE REHABILITATION ON A GLOBAL SCALE: A HISTORICAL JOURNEY

During the late 19th and early 20th centuries, the focus of medical research on stroke primarily revolved around clinical observations, pathology, clinical-pathologic correlations, and understanding the underlying mechanisms. However, there were minimal efforts towards the retraining or rehabilitation of stroke patients during this time. While a few individuals can be recognized as early advocates of rehabilitation concepts, their influence was limited, and their suggested treatments were not consistently applied [1].

As recently as the mid-1950s, patients who had suffered a stroke were typically placed in nursing homes or secluded in the back rooms of their homes, often confined to complete bed rest. Unfortunately, under such conditions, the patients' health would rapidly deteriorate, leading to frequent complications such as bedsores, muscle spasms, muscle atrophy, and infections. Adding to the problem, hospitals lacked dedicated physical therapy departments, and outpatient physical therapy resources [3].

During the 1970s and 1980s, there was significant progress in stroke rehabilitation with the emergence and expansion of the stroke rehabilitation team approach. Stroke units were established in larger urban hospitals, offering a smooth transition between acute care and rehabilitation. Moreover, outpatient rehabilitation resources were developed, which included services from health departments, visiting nurse associations, independent physical therapy practices, free-standing day care centers, and rehabilitation facilities associated with hospitals. These developments played a crucial role in enhancing stroke patient care during this period [4].

From the 1970s onwards, and especially from the 1990s, it has become evident that structured inpatient multidisciplinary rehabilitation during the post-acute phase offers significant clinical advantages. Studies have consistently shown that stroke patients who undergo inpatient rehabilitation delivered by a well-coordinated multidisciplinary team have higher chances of regaining their ability to perform daily activities, greater likelihood of returning to their community, and a reduced risk of mortality [2]. These results have been found to be consistent across various meta-analyses and recent controlled trials. While most of the functional improvement following a stroke is attributed to spontaneous recovery, there is an increasing body of evidence since the 1990s that indicates a modest yet clinically significant benefit of stroke rehabilitation. This benefit is generally observed in patients with, at most, moderate disability [12].

In the early 20th century, some of the precursors to rehabilitation methods included repetitive exercises aimed at improving aphasia, which involved tedious repetition of reading, spelling, and word repetition. Additionally, for individuals with severe limb

paralysis, passive limb movements were employed, electrical stimulation for muscle wasting, while those with milder paralysis underwent exercise programs. Various orthotic and assistive devices like splints to prevent contractures, lightweight braces for support, canes, crutches and wheelchair were also utilized during this period [12]. Additionally, several surgical procedures were attempted to restrict contractures or spasticity [2].

In recent times, significant strides have been made in the field of stroke rehabilitation, representing substantial advancements in the scientific understanding and treatment of this condition.

THE EVOLVING LANDSCAPE OF STROKE REHABILITATION: UNRAVELING GLOBAL TRENDS AND INNOVATIONS

Stroke recovery is a diverse and intricate process, likely resulting from a combination of both spontaneous and learning-dependent mechanisms. Many efforts have been made to maximize the neurological recovery of motor impairment during recovery after stroke. Treatment of stroke in acute stage includes Intravenous thrombolysis which has been recommended as evidence-based treatment in stroke guidelines where intravenous tissue plasminogen activator is administered within 4.5 hrs of symptom onset [7]. Similarly, mechanical thrombectomy is used to treat acute stroke patients with large artery occlusion using a new generation of endovascular tools, stent retrievers are found to improve functional outcome in stroke patients [8].

To optimize the recovery, therapy should be administered in the patient's natural environment and commence promptly after the stroke event. The training should be focused on highly functional activities, tailored to address the individual patient's specific goals and needs [13]. Organized inpatient stroke unit help reducing death from secondary complications of stroke and the need for institution [10]. Studies have shown that, stroke rehabilitation should start as soon as possible after a stroke preferably within a stroke unit [6]. Rehabilitation of motor impairment in stroke patients in developed countries includes.

Biofeedback

A recent meta-analysis comprising 13 trials revealed a favorable outcome in terms of grip strength and upper limb function [14]. A systematic review of 18 trials concluded that compared to conventional treatment, biofeedback was more effective in improving the motor function of the lower extremities [10].

Non-invasive brain stimulation techniques

Numerous studies have investigated the application of non-invasive cortical stimulation methods to enhance neuroplasticity and facilitate recovery in individuals who have suffered a stroke [15,16]. A small, non-randomized study examining the use of rTMS in combination with intensive occupational therapy for upper limb hemiparesis found that it led to improved motor function in the affected limb, and no adverse effects were reported [17].

Stem cell therapy

Stem cell therapy represents a novel therapeutic approach to facilitate recovery after stroke and there are ongoing efforts to advance research in this field. This innovative treatment promotes revascularization and reduces cerebral inflammation following a stroke [18-20].

Robotic therapy

Recent advancements in robotic devices have revolutionized stroke rehabilitation by offering enhanced control over passive upper limb movement and providing assistance or resistance to single joint movements and facilitating inter-segmental coordination. Evidence suggests that robot training for hand rehabilitation is more effective in post-stroke rehabilitation compared to other approaches [21,22]. In a systematic evaluation of lower extremity exoskeleton robots, these wearable exoskeletons in early rehabilitation showed enhanced functional recovery and supporting daily life activities [23].

Virtual reality

The Microsoft TM Kinect-based system offers feedback on the execution of movements or the achievement of specific goals. By integrating therapy exercises into virtual games, the rehabilitation process becomes more enjoyable and lifelike, thereby enhancing the overall therapeutic experience [24].

Whole body vibration

The latest findings on whole body vibration showed a positive effect on the improvement of lower extremity spasticity in stroke patients. A recent randomized controlled trial reported that whole body vibration reduced the ankle plantar flexor spasticity and increased intramuscular blood perfusion in stroke patients [11].

Functional electrical stimulation

Application of functional electrical stimulation combining with conventional therapy has been found helpful in improving balance function, gait function after foot drop, and gait speed of stroke patients. Likewise, a recent randomized controlled trial confirmed the positive effect of multi-functional electrical stimulation on gait training with subacute stroke patients [25-27].

Treadmill training

A Cochrane review in 2017 stated that treadmill training improved gait speed, endurance, distance for stroke who cannot walk independently. In another randomized controlled trial, virtual reality training was implemented along with treadmill training to improve patient participation with their walking ability [28,29].

Mirror therapy

Mirror therapy was reported to be effective in significantly improving the upper and lower extremity movements on the

affected side and the activities of daily living. However, the meta-analysis published between 2020-2021 showed mirror therapy had little effect on the recovery of hand function [30,31].

Constraint Induced Movement Therapy (CIMT)

A RCT showed that the application of CIMT led to significant and meaningful enhancements in the motor skills and usage of the affected arm which involved wearing a mitt on their less-affected hand and practicing repetitive tasks while shaping their behavior with the hemiplegic hand when compared to those who received standard care [32].

Brain Computer Interface (BCI)

There is some indication that BCI can play a role in stroke rehabilitation by enabling the control of functional electrostimulation devices for improving foot drop, aiding in robot-assisted therapy for upper limb rehabilitation and facilitating motor imagery therapy techniques [33-35].

Exercise in stroke

There is evidence from multiple studies that increased time spent on exercise (augmented exercise therapy) in the first 6 months post-stroke results in significant improvements in walking ability and speed as well as extended activities of daily living [36,37].

Aerobic exercise

Positively impacts changes in the metabolomic profiles of patients with chronic stroke and has a positive effect on gait speed in individuals who have had a left-side stroke [38]. Moderate enforced exercise can reduce the volume of the lesion and provide protection to the tissue surrounding the lesion from oxidative damage after stroke [39]. Walking speed exercise can improve cognitive function in patients with chronic stroke [40]. Physical exercises combined with cognitive training produced greater benefits on cognitive function in survivors with vascular cognitive impairment [41]. Chinese traditional exercises could help reduce symptoms of anxiety and stress and improve the sleep of the patients with stroke [42]. Treadmill training with a robotic exoskeleton after incomplete spinal cord injury resulted in improved left ventricular and endothelial function [43].

Task-oriented rehabilitation

The ICARE RCT among patients with motor stroke and primarily moderate upper extremity impairment, use of a structured, task-oriented rehabilitation program did not significantly improve motor function or recovery beyond either an equivalent or a lower dose of UCC upper extremity rehabilitation [44].

Symmetrical Body-Weight Distribution (S-BWD) training

A study demonstrated that (S-BWD) training can enhance the ability of stroke patients to transition from sitting to standing,

thereby reducing the incidence of falls. Patients who underwent this training exhibited notable enhancements in their sit-to-stand performance [45].

Electroacupuncture therapy

In the context of stroke patients experiencing muscle spasms, the use of electroacupuncture on both opposing and active muscle groups has been found to enhance muscle tissue excitability through intermittent wave stimulation and short-term application of low-frequency continuous waves can also stimulate muscle activity. However, prolonged use of this method has found to lead to a suppression of sensory and motor nerves, as indicated in a study [46].

Computer assisted technology

A study involving individuals who had experienced strokes over an extended period demonstrated that enhancing motor function through computer-assisted technology had a positive impact on the brain [47].

Telerehabilitation

Chen et al., illustrated that both telerehabilitation and conventional rehabilitation had a substantial positive impact on arm motor function [48]. Likewise, Knepley et al., conducted a review of literature on telerehabilitation determining that telerehabilitation is a cost-effective and superior option compared to in-clinic rehabilitation for enhancing functional capabilities and emphasized that it can be integrated with various treatments, like virtual reality in stroke patients [49].

Music therapy

The advantages of Music Therapy (MT) are evident in terms of the recovery of upper limb motor skills and hand-related functionality, and these benefits are observed to endure during the 6-month post-treatment assessment [50].

MDT-delivered therapy

A Cochrane review, which evaluated the impact of therapy-based rehabilitation services delivered by Multidisciplinary Teams (MDT) to stroke patients living in the community within 1st year following a stroke or discharge from the hospital, documented a decrease in the probability of unfavorable outcomes such as death or a decline in the ability to carry out daily activities for patients residing in their homes [51].

DISCUSSION

Revisiting the history of rehabilitation concept in Nepal

Rehabilitation Institutions in Nepal have predominantly been established and promoted by International Non-governmental Organizations (INGOs) and domestic Non-governmental Organizations (NGOs). Some hospitals within the country primarily provide inpatient rehabilitation care. An example is

Green Pastures Hospital, which was initially founded in 1957 by the International Nepal Fellowship to serve as a facility for leprosy patients. The idea for the Hospital for Rehabilitation and Disabled Children was born from the vision of Nepali orthopedic surgeon Professor Doctor Ashok K. Baskota who initiated efforts to assist economically underprivileged individuals with disabilities during the 1980s. The hospital also accommodates a comprehensive program focused on Community-Based Rehabilitation (CBR). Subsequently, in the late 1990s, it broadened its scope to offer rehabilitation services to individuals with Spinal Cord Injuries (SCI), stroke, and traumatic brain injuries [52].

The inauguration of Nepal's dedicated stroke unit and clinic transpired in 2018. The inaugural mechanical thrombectomy was performed in 2019 by Dr. Subash Phuyal within our country's first biplane Cath-lab, benefiting a 50-year-old patient. In 2021, the Nepal Stroke Association launched a nationwide endeavor, in collaboration with scientists from the University Hospital Heidelberg, aimed at delivering basic stroke care to all which also enlisted the participation of 20 hospitals and continues to expand its scope. The endeavor is made possible through funding from the Hospital Partnerships program of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, with financial support from the Federal Ministry of Economic Cooperation and Development (BMZ) and the Else Kröner-Fresenius Foundation (EKFS) [53].

In the realm of stroke management in Nepal, various strategies have been introduced to address time constraints and safeguard the penumbra, the at-risk brain tissue adjacent to the stroke-affected area. Advanced healthcare facilities are primarily concentrated in the capital city, Kathmandu, and in Pokhara. Notably, there isn't a government-operated rehabilitation hospital in Nepal. Endovascular treatments, such as the clot retraction technique, are also accessible in Nepal, and these methods have demonstrated significant efficacy and positive outcomes [54].

In Nepal, fewer than 10 centers are equipped to provide IVT, and only three possess the capability to perform MT, all situated in the capital city. Furthermore, there exists a scarcity of healthcare professionals specializing in stroke care, with the country harboring only 25 neurologists, a few endovascular neurosurgeons, and neuro intervention radiologists [55].

Over the past decade, we have witnessed significant strides in our comprehension of stroke management and its associated outcomes. The outlook for stroke patient care has evolved from one of pessimism to one brimming with optimism.

Stroke incidence and management in Nepal: A comprehensive overview

According to WHO estimates, cerebrovascular disease was the cause of 107.5/100000 deaths in Nepal. According to the report published in 2012, stroke is the major cause of death and is one of the top five diseases in Nepal based on disability adjusted life years [56]. Stroke management in Nepal has seen the introduction of various strategies to combat time constraints and preservation of the penumbra, the at-risk brain tissue

surrounding the stroke-affected area. These initiatives include stroke units, emergency ambulance services, tele-stroke networks, mobile stroke units, advanced imaging techniques (such as CT and MR angiography, perfusion scanning), Intravenous Thrombolysis (IVT), and Mechanical Thrombectomy (MT). IVT and MT are currently established therapies for treating Acute Ischemic Stroke (AIS) [57]. Recently, tPA has been approved for use in selected patients with acute ischemic stroke in Nepal [58]. Although its utilization is still relatively low, there is a growing trend in its adoption across the country.

Furthermore, decompressive craniectomy is an available option for malignant infarction in Nepal, but its impact on improving the quality of life for patients is limited [54]. Strategies like STA-MCA bypass, carotid endarterectomy, and carotid artery stenting are employed to prevent recurrent strokes but are only performed at selected centers [58]. A recent article found that direct aspiration first pass technique using large-bore aspiration catheters appeared to be fast simple, safe and effective treatment in Nepali population [59].

CONCLUSION

The rehabilitation of stroke in Nepal has achieved bigger milestones in neuro intervention radiology and pharmacological management. The presence of motor as well as nonmotor impairments long after the acute episode however draws a bigger attention to rehabilitations. As evidenced by current literature and articles there are very minimal research and innovations made by physiotherapist in stroke management. We could see physiotherapist following some global trends for the overall recovery of stroke cases in the clinical practices, but the current research evidence is negligible to be considered. Very few articles have documented about the positive effect of early mobilization concept, motor relearning program, constraint induced movement therapy, task-oriented training, physical activity, robotics, and conventional physiotherapy exercises on optimal recovery of stroke clients. Therefore, present scenario of stroke rehabilitation by physiotherapist in Nepal suggests global platform for research and innovations for future.

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