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Case Report

Significance of Physiotherapy Management in Polyneuropathy in Pediatric Patient with CKD

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ABSTRACT

A 10year old female with polyneuropathy associated with chronic kidney disease presented with knee joint pain, bilateral ankle joint stiffness, numbness in distal extremities and had difficulty in walking without assistance. She was on maintenance hemodialysis twice a week. Her comorbidity included hypertension. She was almost bed bound and dependent with respect to all activities of daily living. Examinations revealed generalized muscle weakness, poor balance and diffused DTRs. The NCV study showed motor sensory axonal neuropathy. Polyneuropathies could be a consequence of systemic illness. In case like such coordination of clinical care becomes the crucial component in management. Multifactorial exercise rehabilitation improved muscle strength, functional ability and fatigue along with pain relief. Exercise is a supportive therapy for neuropathic patients associated with CKD that ought to be viewed more in a serious way.

KEY WORDS: Polyneuropathy, Chronic kidney disease, Physical exercise.

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INTRODUCTION

Peripheral nerves are vulnerably affected in peripheral neuropathies. They are group of disorders that impair one or a lot of parts of the peripheral system, primary medulla, axon, or combination of the two [1].

Polyneuropathies could also occur as a result of systemic illness. Many neuropathies are due to well-defined causes such as diabetes, uremia, or nutritional deficiencies. It is also one of the typical complication of chronic kidney disease (CKD) that has a considerable negative impact on patient's health-related quality

of life (HRQOL) [2]. The majority of individuals with renal failure have complex peripheral and central nervous system problems. Uremia has long been known to cause nerve damage. Uremic polyneuropathy is more common in dialysis patients with a glomerular filtration rate of 12mL/min [3]. The patient usually complains of motor or sensory problems, or both. In motor disturbance the patient might report muscle incoordination, distal weakness (causing frequent tripping and troublesome walking on uneven surfaces), or proximal weakness (causing issue with getting out of a chair and with ascending and descending stairs). Sensory shows embrace feelings of tingling, burning, stabbing, throbbing, clumsiness, cold, hot, etc. [3]

CASE REPORT

A 10-year-old female visited rehabilitation department on 4/4/2022 with reference from pediatric nephrologist with chief complains of numbness in distal extremities, knee joint pain, bilateral ankle joint stiffness and difficulty in walking without assistance. She was also a candidate waiting for renal transplant as she was diagnosed with CKD and was on, maintenance hemodialysis twice a week.

Upon presentation she was a bit lethargic but was able to follow commands and respond to the questions but was unable to elucidate many details of her medical history. Her parents were present and provided the progression of her history. She suffered from Covid-19 in April-2021. Shortly after the resolution of COVID, she developed multisystem inflammatory syndrome [MIS] and as a consequence of the same just after 2 months in June-2021 she was diagnosed with CKD which was managed conservatively. In July-2021 she got diagnosed with an extrapulmonary tuberculosis which was managed by antitubercular drugs. Later after 9months in March-2022 her liver function tests got altered, due to ethambutol toxicity. Thus, all of her AKTS were stopped. Additionally patient also reported of cold intolerance, loss of appetite since few months.

The patient's vitals were stable and physical examinations were unremarkable. She had mesomorphic build with slouched posture and pes cavus bilaterally. Muscle force was assessed and individual MMT (manual muscle test) grades were assigned using a modified Medical Research Council (mMRC) grading, upper limb it was grade 4- full range of motion (ROM) against gravity with minimal resistance and grade 3 in lower limb that is full rom against gravity. However, for more objective and quantitative data, measurement with hand held dynamometer was done in which she was able to keep up to 15kgs. In neuromuscular system: all the cranial nerve functions were intact, diffuse hyporeflexia type of presentation was observed overall and all the sensations including of touch, vibration, proprioception, pain, temperature etc. were normal. Dermatomes and Myotomes were intact as well. Her laboratory markers were significant for the following.

Table 1: Laboratory data of 22/3/22.

Serum urea	**81 mg/dL**
Serum creatinine	7.04 mg/dL
C-reactive protein	46 mg/L
Hemoglobin	8.00mg/dL
S. electrolyte Na+	135.6mEq/L
S. electrolyte K+	5.25mEq/L
Parathyroid hormone	84.71pg/ml

Blood analysis Blood CS indicated an infection of growing staphylococcus and antibiotics linezolid and meropenem were started. Currently she was on tablet feronia, capsule calciferol, tablet arkamin and bisoprolol.

A diagnosis of motor sensory axonal neuropathy was supported by the findings of nerve conduction study.

To assess patient's current status and HRQOL pediatric balance scale, fatigue severity scale and short form-36 were taken.

1. SF-36: To measure HRQOL. Each of 8 health concepts-physical function, role limitation (physical), bodily pain, general health, vitality/energy, role limitation (emotional), social function, and mental health-were measured on a scale of 0 to 100, with a higher score indicating better health.

2. FSS: 9-item scale to measure the severity of fatigue and its effect on her activities and lifestyle, consisting of answering a short ques-

-tionnaire of her own level of fatigue that are scored from 1(strongly disagree) to 7 points (strongly disagree) with a maximum total score of 63 points.

3. PBS: To assess functional balance skills. The scale consisted of 14 items in which the patient was asked to come from sit to stand, transfers, reach outs etc. that are scored from 0 points (lowest function) to 4 points (highest function) with a total maximum score of 56 points.

4. For muscle strength Handgrip strength was assessed using the Jamar handgrip dynamometer.

INTERVENTION

Figure 1 Coordination of clinical care is crucial component in the management of Polyneuropathy associated with CKD. The care was best provided in a multidisciplinary setting by a collaborative effort of health care professionals including pediatric nephrologist, neurologist, rehabilitation specialist etc. Multifactorial intervention approaches were used to enhance Balance, Strength, Aerobic capacity, Flexibility and Pulmonary reconditioning.

Respiratory Training: Incentive Spirometer, Segmental expansion, pursed lip breathing exercises were included. For pain management: Transcutaneous electrical nerve stimulation (TENS) modality(2-5Hz).

The intensity of exercise was light that is 20-40% of maximum heart rate, frequency: 3days/week on the non-dialysis days. Exercise session lasted for about 40-45min/day which included: Aerobics exercise- Static bicycle, slow walking. Flexibility: Gentle stretching of all the major muscles. Resistance: Free weights (dumbbells), therabands. Balance training: Modified Frenkel's exercise, sit to stand and reach outs on exercise ball.

Figure-2 states that there is significant improvement in the subject's fatigue, balance and muscular strength after the rehabilitation. Figure-3 illustrates the HRQOL measurements for each scale of the SF-36. Performance on the role limitation (physical), role limitation (emotional), and social function scales of the SF-36 have improved following the exercise intervention.

RESULTS

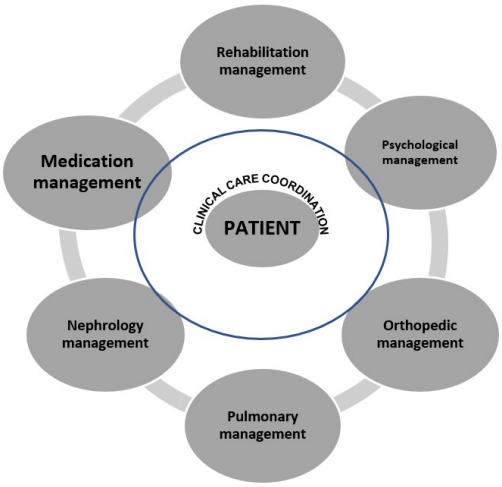

Fig. 1: Coordination of clinical care.

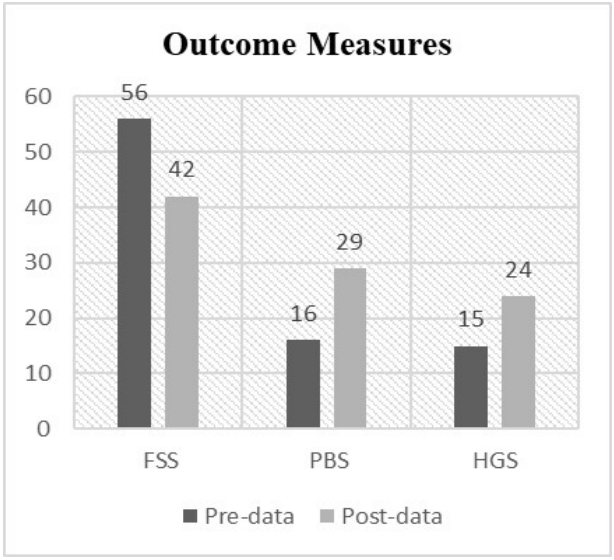

Figure-2:

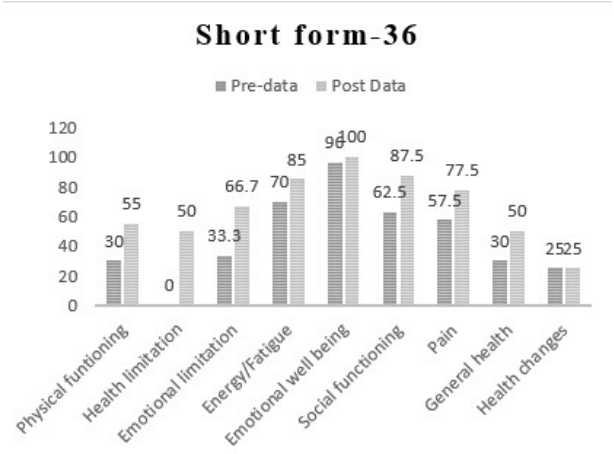

Figure-3

FSS= Fatigue severity scale, PBS= Pediatric balance Scale, HGS= Hand grip strength

DISCUSSION

Patients with CKD, particularly those on long-term dialysis, frequently experience muscle wasting and fatigue, which can lead to uremic myopathy, neuropathy, and anemia. The precise mechanism of uremic neuropathy is unknown, however accumulation of neurotoxic uremic toxins: β2-microglobulin or phenols is one amongst the postulated causes [4]. Dialysis does not cure uremic neuropathy. This disorder can only be cured through a kidney transplant. A recent case study done by Titi Chen explicates that the subject's neurologic symptoms improved dramatically after transplantation, and could walk with a walking stick at 1 month [5]. Thus, successful kidney transplantation represents the most effective therapy of uremic PNP [3]. Likewise, the above-mentioned intervention protocol would fill in as the Prehabilitation which attempted to upgrade a patient's functional capacity before the surgery to bear an impending physiologic stressor.

Axonal nerve degeneration, muscle myosin loss, and muscle necrosis are structural alterations linked with critical illness neuropathy (CIP). Electrical in excitability of neurons and muscles, as well as reversible muscle weakness, can result from functional changes. Energy supply and usage may be disrupted by microvascular alterations and cytopathic hypoxia. [2]. Physiotherapy and other therapeutic approaches acting by movement, as well as using electric and thermal stimuli, promotes physical function improvement and functionality. Regular exercises of moderate intensity tend to favor sensory motor functions and the regeneration potential of injured axons [1]. Long-term high-doses of corticoids and immunosuppressors are commonly used to treat neuropathy/myopathy, which can result in persistent bone, muscle, and metabolic damage. Exercise, emerges therefore, as an alternative not only to neutralize some of the deleterious effect of disease, but also to improve other relevant quality of life factors, such as body composition, muscle strength and balance.

R. Afshar concluded that Aerobic exercise and resistance training have beneficial influence on functional capacity, quality of life, cardiovascular risks factors, anemia, lipid levels, insulin resistance, and inflammatory cytokines in CKD patients [6]. Koufaki stated that only aerobic based exercise improves indices of cardiovascular fitness and significant improvements were noted after 3 months of exercise training, in CKD patients [7].

Antonio Nardone reported balance rehabilitation with either modified Frenkel exercise or powered platform improves balance in patients with neuropathy [8].

Kosmadakis found that in patients of CKD undergoing dialysis there is an impaired activation of the motor neurons by the central nervous system which contributes to the muscle atrophy. In such patient's exercise [aerobic & resistance] improves anxiety symptoms as well as the physical and mental health scores of the SF-36 quality of life scale [4]. For pain, Juliana Barcellos de Souza stated that TENS(2-4Hz), therapy was well tolerated and effective to handle peripheral neuropathies and there have been no reports of adverse effects. Possible action mechanisms of electrotherapy would be related to local release of neurotransmitters, such as serotonin, adenosine triphosphate (ATP) and endorphins, activates analgesia-producing from central mechanisms [9].

To our knowledge this is the first case study which reports about a pediatric patient with polyneuropathy associated with chronic kidney disease. In this patient towards the end of 2months of rehabilitation we were able to see significant improvements in her balance overall muscular strength, declining fatigue levels and alongside decrease in pain.

CONCLUSION

In CKD patient has loads of comorbidities such as anemia, dialysis, lack of nutrition, muscle wasting etc. from which, neuropathies and its symptoms are ignored. Though it is uncommon to see neuropathy in CKD patients we found that exercise was the safest, feasible and promising approach. Exercise interventions were associated with significant improvements in muscle strength, functional ability, quality of life, balance and fatigue. Apart from the obvious effect of strength training preventing muscle loss, it also improves neural control, contributing to

improved stability and gait. Therefore, exercise is a supportive therapy for neuropathic patients that ought to be viewed more in a serious way.

Future recommendations: It is tempting to speculate about whether chronic exercise training can alter the natural course of the polyneuropathy, delaying the progression of the disease or preventing a poor outcome. Large randomized controlled clinical trials should test this intriguing hypothesis.

ABBREVIATION

CKD- chronic kidney disease
HRQOL- health related quality of life
TENS- transcutaneous electrical nerve stimulation
NCV- nerve conduction velocity
DTR- deep tendon reflex
MMT- manual muscle test
MRC- modified medical research council
SF-36- short form 36

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